

# Criterion – 2

## Teaching-Learning and Evaluation

### NAAC- SSR (2<sup>nd</sup> Cycle)



**ETERNAL UNIVERSITY**

BARU SAHIB, SIRMOUR-173101  
HIMACHAL PRADESH

# 2.3.1(1)

## Experiential Learning



**ETERNAL UNIVERSITY**

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# Student-centric Methods for Effective Learning Process

Eternal University since its inauguration is entrusted to ensure the holistic development of the students through student-centric learning processes. We adopt hands-on learning skill among students by supporting them much necessary facilities for cooperative action and problem-solving abilities through dynamic involvement in real-life tasks. All these are amalgamated suitably in our curriculum. The following exercises provide the comprehensive spectrum of initiatives undertaken in the university to make the learning student-centric:

**Student discussions, Presentations, Magazine and Newsletter:** Students of various colleges have initiated clubs under the mentorship of faculty members. These clubs are boosted to conduct discussions, presentations, write articles for magazine magazines and develop newsletters on current topics to enrich their learning experience.

**Industrial Visits and Field Visits:** Departments organize either industry visits or field visits for students to provide experience and to get comprehension into the core working environment of the industries. It induces students to the real challenges that organizations face in the business world.

**Guest Lectures and Workshops:** As part of academic development, all colleges organize guest lectures and workshops on regular basis on emerging and cutting-edge technologies such communication skills, IPR, flow cytometry, research methodology, healthcare, nursing, resume writing, autism disorder, engineering, bonsai, floriculture, professional development, pedagogy etc.

**Thesis/Dissertation:** Post-graduate students are offered research courses as part of their curriculum to promote self-learning under the mentorship of faculty members with systematic monitoring structure.

**Internships:** Students from certain colleges/program are asked to opt for internships with fixed credits in organizations. It imparts a vision to translate classroom learning into practice in the organizations.

**ICT Enabled Teaching:** This includes Learning Management System, Wi-Fi enabled classrooms with LCD, Language Lab and Smart Classrooms. E-learning resources including e-PG-Pathshala, SWAYAM, J-Gate etc. are extensively made available for student's studies and research work.

**Group Learning:** For active involvement and exchange of ideas, events are organized on a continuous basis like poster competitions, idea generation forums, and entrepreneurial events. Group assignments, group discussions and quizzes are part of the curriculum design that ensures peer learning.

## Student-Centric Methods for Enhanced Teaching-Learning Process

Learning Process/Method	Experiential Learning	Participative Learning	Problem Solving
<b>Group Discussions</b>	●	●	●
<b>Students' Presentations</b>	●	●	●
<b>Industrial Visits</b>	●	●	●
<b>Exploratory Field Visits</b>	●	●	●
<b>Guest Lectures and Seminars</b>	●	●	●
<b>Workshops and Conferences</b>	●	●	●
<b>Thesis/Dissertation</b>	●	●	●
<b>Internships</b>	●	●	●
<b>ICT-enabled Teaching</b>	●	●	●
<b>Events and Days Celebration</b>	●	●	●
<b>Publications in Journals, Magazines and Newsletters</b>	●	●	●



## Experiential Learning

### **Akal International Youth Camp (27 July 2018 to 27 August 2018)**

The students of Akal College of Arts and Social Sciences trained NRI students (America, Canada and England) in Shabad Kirtan, Aasa Ki Vaar, various String Instruments, Dhadhi-Waran, Tabla and Poems. Nearly 150 performances for Gurmat Parchaar were organized by the students of Department of Music.



### **Students of Music performed at Patna Sahib and England:**



**Students of Music Dept. performing at Patna Sahib (Dec. 2018)**



**Students performing at Gurudwara Haveloch Road, Southall, United Kingdom in Nov. 2018**

#### 4<sup>th</sup> International Educational Workshop

Akal college of Education in collaboration with Akal Academy, Baru Sahib and McGill University, Canada organized this workshop from 1st – 4th October, 2018. The Workshop was focused on Fostering 21st Century Pedagogical Skills- Special Education Needs. Two of the eminent facilitators (Dr. Juss Kaur Magon and Dr. Elena.P. Soukakou) from abroad were invited as resource persons. The workshop was attended by 92 participants including B. Ed. trainee.



**B.Ed. Trainees with International Resource Persons**



**Interactions with Resource Persons**



**Workshop session conducted by Dr. Elena Soukakou**



**Workshop session by Dr Wasim Ahmed**



### **8<sup>th</sup> International Nursing Conference on “Global Perspectives on Better Mental Health”**

An International conference was organized from 12-13<sup>th</sup> October, 2018 by Akal College of Nursing in collaboration with Drexel University, Philadelphia, USA. Twenty resource persons including 5 each from USA, Holland and UK participated. From all over India 360 student delegates from Punjab, Himachal Pradesh, Haryana, Chandigarh, J&K, Uttarakhand, Maharashtra, Delhi, Pondicherry and Kerala attended the conference. Keynote address was delivered by Prof. Bimla Kapoor, Dean Academic, Berkeley Health EDU, New Delhi, and she spoke on the issues of Mental Health and how ignoring it can be fatal for a society. Honourable Baba Iqbal Singh Ji, Chancellor, Eternal University shared pearls of wisdom with the attendees and felt the need to create awareness about mental health. The speakers shared their views on Values in Health Care-A spiritual Approach, Mindfulness techniques, Positive relationships, Mindfulness in Classrooms, Building Resilience, and Adolescent Mental Health.



### **Workshop on Applied Aspects of Psychological Principles in Daily Life**

Department of Psychology, Akal College of Arts & Social Sciences organized workshop on 7-8<sup>th</sup> March, 2019 for the B.Sc. Psychology Students on Applied Aspects of Psychological Principles in Daily Life. The focus of workshop was on the areas like Emotional Intelligence: Building Positive Attitude and Motivation, Goal Setting, Time Management, Problem Solving & Creativity, Effective Communication Skills, Counseling Techniques, etc. The workshop was conducted by Dr. Sohan Chandel, a renowned Psychologist and motivational speaker. The objective of the workshop was to share practical knowledge of psychology among students and motivate them to use creative and effective ways to deal with the day to day problems. The workshop was highly enriching and was a great source of inspiration amongst participating students and faculty members as well.



### **4<sup>th</sup> Annual Kisan Mela**

The Akal College of Agriculture organized 4<sup>th</sup> annual Kisan Mela on April 14, 2019. Hon'ble Sh. Rakesh Kanwar (IAS), Director-cum- Ex-Officio-Spl. Secretary, Panchayati Raj Department, Govt. of Himachal Pradesh was the Chief Guest on the occasion. During the Kisan Mela, more than 25 exhibits/stalls were displayed by students as well as by state departments, pesticides companies, book depot, agri-implements firms etc. Local farmers and various distinguished guests enthusiastically participated in various activities during the event.





## National conference on New Insights in Biological and Environment Sciences

Department of Botany, Akal College of Basic Sciences, organized National conference on New Insights in Biological and Environment Sciences on 24-25<sup>th</sup> May, 2019. 115 delegates from different parts of the India attended the conference. Conference chief guest Shri H. S. Kingra (Retd. Add. Sec., GOI, IFS delivered his inaugural address. Invited talk was given by Dr. B.D. Sharma (Medicinal plants science without scientific rationality). Other distinguished speakers, Dr. Pratyosh Shukla and Dr. D. R. Batish also gave their presentations. Special talk was given by Dr. H. S. Dhaliwal on topic “Recent advances of plant biotechnology to keep the green revolution ever green”. In valedictory session first prize was awarded to Ms. Ranjan Pandey for her research topic: ‘Degradation of Hydrocarbons and biosurfactant production by *Fictibacillus* sp. strain’. In student’s poster presentation five prizes were given. Ms. Ambika Sharma, Ph.D. student of Eternal University got first prize.



## One Day Awareness Seminar on Importance of Intellectual Property Rights

IPR Cell, Eternal University Badu Sahib and PHD Chamber of Commerce and Industry under the aegis of office of the Controller General of Patents, Designs & Trade marks, Ministry of Commerce and Industry, Government of India has organized a One day awareness Program on "Importance of Intellectual Property Rights" on Saturday, 30th November 2019 at university auditorium, Eternal University Badu Sahib, Himachal Pradesh. More than 160 participants from various colleges of Eternal University which includes faculty members, research scholars and postgraduate students have participated. The main aim of this workshop is to disseminate information and aware all the participants about IPR. The speakers from various organization aware participants about various forms of IPR like Patents, Copyrights, Trademarks & Service marks, Geographical Indicators, Industrial Designs, Trade Secrets, Plant Varieties, Semi-Conductor Integrated Circuits lay out design. This workshop also covered the patentable and non-patentable invention along with how to commercialize patent and technology transfer.





Mr. Sudarshan Kumar Bansal, Senior Partner, United IPR delivering inaugural address



Participants attending the deliberations of the seminar

### **21<sup>st</sup> INDO-US Flow Cytometry Workshop**

Department of Plant Breeding Genetics and Biotechnology, DKSGACA, Eternal University and Trust for Education and Training in Cytometry (TETC) in collaboration with International Society for Advancement of Cytometry (ISAC), Live Education Task Force (LETF) jointly organized 21<sup>st</sup> INDO-US Flow Cytometry workshop on “Basics of Flow Cytometry and its Applications in Plant Biology” on 6th -7th Feb 2020 at Eternal University, Baru Sahib, Himachal Pradesh. The Chief Guest of the workshop was Dr. R C Sobti (Padma Shri; Former Vice Chancellor Panjab University, Chandigarh & Babasaheb Bhimrao Ambedkar University, Lucknow). Dr. Arvinder Singh, Co-founder and Trustee of TETC attended the function as a Guest of Honor. Sysmex India and Thermo Fisher Scientific were two Industry Partners who have given live demonstration on flow cytometry instruments. Along with guest faculties there were 110 participants in workshop. Participants were provided with the knowledge to understand potential technical issues with the flow data analysis and presentation.



## Workshop on Research Methodology

This workshop was organized by Akal College of Nursing on 10<sup>th</sup> October 2019. More than 9 colleges from different states of the country have participated in the workshop. Total no. of registrations of delegates was 200. The topics included in workshop were review of literature, research designs, sampling technique, sample size calculation, data analysis, SPSS hands on skill. There were certain credit points which were being given by HPNRC with permission granted from INC with enormous efforts of Registrar (HPNRC). This is the first Workshop organized in H.P. with CNE accredited points. CNE hours for one day workshop on “Research Methodology” the participant were awarded by 5 CNE hours and Speaker for each respective session with 10 CNE hours.



## 9<sup>th</sup> International Nursing Conference “Collaborative Approach for Holistic Health Care”

With the continuous efforts of Health and Allied Science faculty the Nursing department has successfully once again organized its 9<sup>th</sup> International Nursing Conference in collaboration with Drexel University, Philadelphia, USA on 11<sup>th</sup> & 12<sup>th</sup> October 2019 which was themed as “Collaborative Approach for Holistic Health Care”. The aim of the conference was to provide a platform for all health care professionals to analyze the significance of collaboration and partnership for enhancement of quality care outcome and to promote the overall health of individual, family, and societal levels. More than 15 colleges from different states of the country



participated in the conference. Total no. of registrations of delegates were 520 including Eternal University and 40 dignitaries (resource persons and chairpersons). There were registrations from 5 countries (India, USA, Oman, Nepal and Afghanistan) and 11 states (Punjab, Himachal Pradesh, Uttarakhand, Rajasthan, Maharashtra, Uttar Pradesh, Delhi, Bihar, Andhra Pradesh, Kerala, Karnataka). This is the first International Conference organized in H.P. with CNE accredited points. CNE hours for conference “Collaborative approach to Holistic Health Care” each participant is awarded with 10 CNE hours, Speaker for their respective session 10 hours and the Session Chairperson/moderator with 5 CNE hours. The conference has total of 5 plenary sessions with 5 lectures in each session. The Best Delegate prize was given to a student of Godavari College of Nursing and a cash prize of Rs. 10,000/- was awarded. The organizers have received an excellent feedback from the participants.



### **RURAL AGRICULTURE WORK EXPERIENCE PROGRAM (RAWE)**

The linkage of agricultural education with the actual farming situations was brought up with the introduction of Rural Agricultural Work Experience programme at Dr. K. S. Gill Akal College of Agriculture, Eternal University, Baru Sahib in 2019-20 academic year, for the final year students of B.Sc. (Hons.) Agriculture. The village attachment programme to the Lana Machher and Lana Marag villages provides a practical oriented opportunity and hands on experience in acquiring knowledge and skill to the students. Students were also aware with the real socio-economic situation of village and problems at field level. The experiential learning process in the different units of Eternal University imparts a direction to the students to think and act and eventually creates self-confidence. It offers direction to the students to develop their competence, capability, capacity building, acquiring skills, expertise and a holistic development. In the last phase of RAWE training programme students visited to Dr. YS Parmar University, Solan and its

associated KVKs. Where students learned about on farm testing of new technologies, such as seed varieties or innovative farming methods. Besides it students saw the front-line demonstration. Future researchers may take up a study exclusively on the extent of communication Skills developed and feedback mechanism operating in the programme. A comparative study of similar programmes in various universities may be beneficial to know which activities we are missing out. A study on effectiveness of the Experiential Learning Programme (ELP) may be taken, so as to know the necessity of introducing Rural Entrepreneurship and Awareness Development Yojana programme in the University under Graduation curriculum.



Visit to apairy unit during experiential learning programme.



Visit to farmer's field during village attachment programme.



Students visit to experimental field of Department of Floriculture and Landscape Architecture, Dr. Y. S. Parmar University of Horticulture and Forestry, Solan



Visit to Directorate of Extension, Dr. Y. S. Parmar University of Horticulture and Forestry, Solan

### **Exposure Visit to Directorate of Mushroom Research, Solan**

An exposure visit of four M.Sc. Biotechnology students was made to ICAR-Directorate of Mushroom Research, Solan by Dr. Roop Singh Bora, Associate Professor on December 17, 2021. Dr. B.L Attri, Principal Scientist of the center conducted the visit of the students and explained that there are 14,000 to 16,000 species of mushroom available but only 300 species are edible and rest are poisonous. He explained that the center is cultivating button mushroom, oyster mushroom, milky mushroom, paddy straw mushroom and shitake mushroom. This center



is working on collection, identification, conservation and genetic characterization of mushroom germplasm, development of high yielding varieties, standardization of production technology and post-harvest technology and integrated pest and diseases management.

**Exposure Visit to Directorate of Mushroom Research:** Another group of six B.Sc. (Hons.) Agriculture 4th year students who had opted for Mushroom Production Technology Module as part of their Students READY Programme along with two faculty members on 26.05.2022, visited ICAR-DMR Chambaghat, Solan to learn about the cultivation technology of different mushrooms. Dr. B. L Attri, Incharge of Technology Transfer, provided a brief history of mushrooms throughout the globe and in India. He then discussed the nutritional and medicinal value of mushrooms in the human diet. He discussed in detail the various cultivation technologies for the most often consumed mushrooms and he

### **Educational Tour to Chinmaya Organisation of Rural Development, & Norbulingka Institute, & Virast-e-Khalsa (Museum of Sikhism)**

An educational tour was organized by the Department of Psychology for students of UG & PG from 23.05.2022 to 27.05.2022. During the tour the students were taken to Chinmaya Organisation of Rural Development (CORD), Norbulingka Institute, Dharmshala, & Vocational Rehabilitation Centre for handicapped (VRC), Una. Students were also taken to Virast-e-Khalsa (Museum of Sikhism), Naina Devi Temple, Bilaspur, on the way to Una, Himachal Pradesh besides some tourist places in Dharamshala i.e., Cricket Stadium, Macleod Ganj, & Bhagsu Nag. The tour was organized keeping in view the theme “Discovering New Insights Through Practice” and to provide opportunities for the students to explore and experience practically what they have learned in the classroom.





## NCC Activities

NCC is optional for the students of the undergraduate programs. Every enrolled student in NCC, required to undergo two years training during bachelor's degree program. An annual NCC training camp was held from 04.12.2021 to 10.12.2021 (Senior Wing) at Eternal University Baru Sahib by the 1 HP Girls Battalion NCC under the aegis of NCC Group Headquartered at Shimla. About 500 Cadets (Girls) of various colleges of Himachal Pradesh attended the camp. The aim of camp was to impart multidisciplinary training including drills, weapon training, map reading, field craft, battle craft, physical fitness, Sports activities, yoga, social service and community development to the cadets for talent and holistic development. The cadets also benefitted by understanding time management, self-discipline and selfless service to the nation and leadership traits.



## NSS Activities

NSS is another programme which is opted by the students in place of NCC. The activities performed by the cadets during the year include: Slogan writing/ poster presentation competition on cyber-crime awareness on 04.05.2022; lecture on "*Cyber Security*" on 01.06.2022 and performing a rally on "*Cyber Security Awareness*" on 06.07.2022.



## Webinar on SAVE SOIL: An SDG Commitment

A Webinar on SAVE SOIL: An SDG Commitment was organized by the Sustainable Development Committee, Eternal University, Baru Sahib at University Auditorium and Bhai Gurdas Hall on 11.05.2022 from 11:00 AM –12:00 Noon. This Webinar was organized on an online mode by the volunteers of Isha foundation and it was attended by over 350 students and faculty members. Ms. Komal Thakur conducted the presentation and Mr. Minak Kalia assisted her in the proceedings. In the webinar students and faculty members were sensitized regarding soil and its significance in the sustainability of the ecosystem. The students were also told about the dependency of all the live forms on soil and its role in the sustainability of the healthy atmosphere. They explained about the objective of SAVE SOIL campaign being run by the Isha



foundation and the motorcycle journey of Shri SADGURU JI across 24 nations for 100 days. They also urged students and faculty to be the part of this campaign by being EARTH BUDDY for which they gave digital links and shared their contact details.



### **Workshop on Elements of Bhakti Raaga in Music & Composition Work in Ragadari**

Department of music organized one day workshop on 25.04.2022. Dr Chamanlal Verma, who is an expert of Hindustani Classical Vocal music and has served as Ex. Dean , chairperson, H.P.U. was invited as the resource person for the workshop. The inaugural session of workshop began with recitation of Gurbani Shabad by B.A. 2nd year Music instrumental students. Dr. Chamanlal initiated the workshop with a vilambit khayal in Raag Ahir Bhairav. He taught the techniques of Bhadat in Vilambit khayal and explain the elements of Bhakti rasa in the „Bhairav“ of the Sawara. He also inspired the students to design their own compositions in ragas. He emphasized that the knowledge of similar ragas is very important to sing any raga with perfection. The session was very enriching as the resource person explained many Ragas on the demand of students.



### **Workshop on Interactive Résumé and Letter Writing**

Department of English organized a workshop on April 26, 2022. In this special training workshop, students were given training as how to highlight your qualifications and skills effectively to get first hand job through an impressive résumé. Résumé is your opportunity to highlight your strengths as a candidate for a position and display that you are qualified.



### **Workshop on Need to Upgrade Communication Skills for Professional Purposes**

One day workshop for the students and faculty of Department of English, Eternal University was organized in the auditorium of the University from 11 am to 1.00 pm on May 23, 2022. The Chief Resource person, Dr. Anjana Tiwari, Prof. in English at National Institute for Technical Teachers’ Training & Research, Bhopal (M.P.), was trainer of the day. Dr Anjana Tiwari started her presentation with Basic Communication Skills which covered areas like reading, writing, speaking, and listening. During the session, the participants were given some very useful information on the use of appropriate language – both formal and informal. She gave tips on Business Writing as well as on grammatical errors.



## **Workshop on Basics of Research Methods and Statistics in Psychology**

Department of Psychology organized two days’ workshop on “Basics of Research Methods and Statistics in Psychology” on 10<sup>th</sup> and 11<sup>th</sup> September 2021. In this workshop Dr C.B. Patil (Chief Psychologist Akal Psychiatric cum Drug De-addiction Centre, Baru Sahib Sirmour, HP) was invited as a resource person. The students of the entire Psychology department and Akal college of Education participated actively to make this event successful.



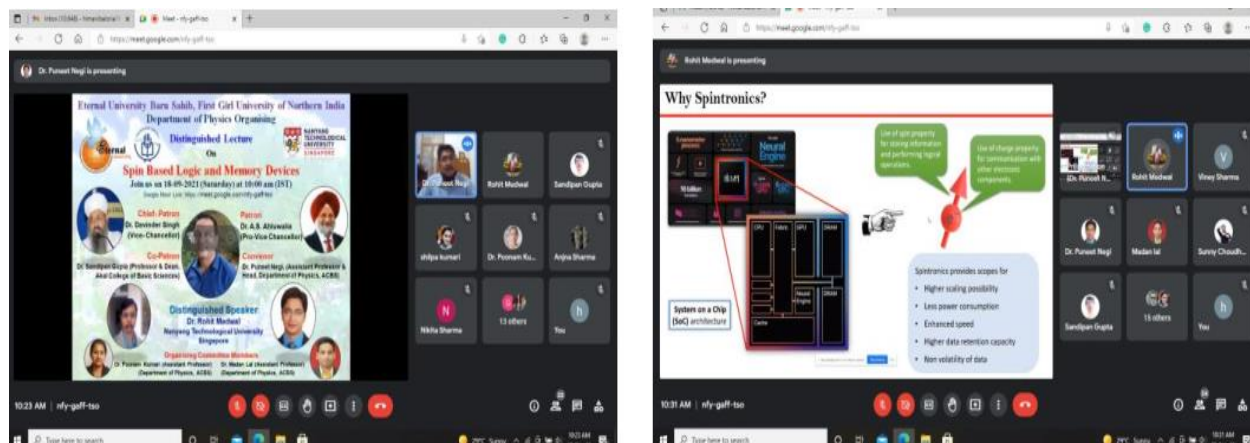
## **Workshop on Autism Spectrum Disorder**

One day workshop was organized by Department of Psychology on Autism Spectrum Disorder (ASD) on 17.05.2022. In this workshop Mr Ankush Dhiman (lecturer special Education with Mental Retardation & specialized in Neurotherapy, Rehabilitation Centre for person with multiple disability Prem Ashram, Una, HP) was invited as a resource person. Autism spectrum disorder (ASD) basically is a neurological and developmental disorder that affects how people interact with others, communicate, learn, and behave. Although autism can be diagnosed at any age, it is described as a “developmental disorder” because symptoms generally appear in the first two years of life. People with ASD can have a range of symptoms. The students of the entire Psychology department and Akal college of Education participated actively to understand various issues related to ASD.



## Motivational Lecture on Spin Based Logic and Memory Devices

A motivational lecture was organized on September 18, 2021 through virtual mode. The lecture was delivered by Dr. Rohit Medwal, from Nanyang Technological University, Singapore. The main objective of this lecture series was to transform the minds of young students and motivate them to opt career in advanced research and technological innovations for the better future development of our society. Faculty members and students actively participated in the lecture.



## Workshop on Development of Bonsai

One day workshop on how to develop bonsai was conducted in the Department of Botany by EU-Botanical Society on 11.09 2021. Invited resource person, Dr. Bhaskar Chaurasia, Department of Rural Technology and Social Development, Guru Ghasidas Central University, Bilaspur (Chhattisgarh) provided hands-on practical training & necessary precautions to the students, research scholars and faculty from Panjab University, Chandigarh, Punjabi University, Patiala, KMV Jalandhar, SGGSWU, DAV College, Hoshiarpur, Eternal University, Chandigarh University, Dr. H.S. Gour Central University, Sagar.



## National Conference on Current Scientific Innovations & Research in Plant Biology

The conference was organised by the Department of Botany, Eternal University, Baru Sahib (H.P.) on 27-28<sup>th</sup> May, 2022. The conference was attended by 150 plus delegates in a hybrid mode in association with Society of Plant Research, Noida and Akal University, Talwandi Sabo, Punjab. In all, six parallel technical sessions were conducted during the conference. PG students with faculty of Eternal University and other institution participated and presented their research work.



Releasing of conference proceedings



Inauguration ceremony



Keynote Speaker Prof S.S Sandhu



Valedictory ceremony

## Webinar on Fundamentals of Investing, Initial Public Offers (IPOs), Buying & Selling of Securities & Impact of Corporate Actions

Two days webinar was organized by the Akal College of Economics, Commerce and Management on 30<sup>th</sup> September and 1<sup>st</sup> October, 2021. Er Amit Gupta was the invited resource person from SEBI. Engineer Amit Gupta meticulously through simple examples imparted knowledge to the participants on primary market, Initial Public Offers (IPOs), the rights and responsibilities of shareholders, book building mechanism, red hearing prospectus, abridged prospectus, and various other issues related to IPOs. Er. Gupta also explained the concept of bonus share and dividends with the help of an example. He gave an example of Infosys to

describe the power of bonus issue to the investors. The students and faculty learn a lot from this webinar.



### National Webinar on Strategy for Managing Personal Finance

National webinar on Strategy for Managing Personal Finance was on 25<sup>th</sup> October, 2021 in collaboration with Association of Mutual Fund of India (AMFI). The webinar was attended by more than 250 participants from various parts of the country. Mr. Deb Bhattacharjee & Mr. Surya Kant Sharma were resource persons. Mr. Bhattacharjee talked about mutual funds, KYC, various types of investors and benefits of diversification. Mr. Surya Kant Sharma touched upon the importance of financial security of individuals. He emphasized that an investor should first think and ensure adequate life insurance, reasonable medical insurance cover and an emergency fund before embarking upon the journey of wealth creation through sustained investments which is most essential for prosperity. The students, faculty members and participants were sensitized with managing personal finance.





## Workshop on “One District One Product” in Collaboration with MGNCRE, Department of Higher Education, Ministry of Education, Govt. of India:

The department of Management organized one day institutional workshop on “One District One Product (ODOP)” was organized by ACECM on 23rd of December, 2021. Dr. Chethan Chittalkar, Director of MGNCRE gave brief introduction of the concept “One district one product”, the importance of entrepreneurship, and specifically entrepreneurship in the context of rural areas. He briefed the participants about the concept of “Experiential Learning” and encouraged students to join the path of entrepreneurship by experience or doing things not by studying only but by trying to learn while learning.



## Workshop on Teacher as a Profession

Educational Workshop on Teacher as a Profession with 63 participants was conducted on 15<sup>th</sup> June, 2022 by the Akal College of Education. Ms Prabhjot Kaur, Professor, Department of English, Panjab University was the key person. She guided B.Ed. trainees to teach 21st century students by amalgamating practical with theory. At the end she had given opportunity to all the trainees to express their thoughts about any topic of their choice. The workshop was very interesting and lively. All the trainees were inspired by different activities being conducted by her.



**Educational trip to Renuka Wetland & Wildlife Sanctuary and Museum and Repository of Zoological Survey at Solan:** Department of Zoology organized one day exposure visit for 16 M.Sc. Zoology students and Ph. D scholars to Renuka wetland on 27.12.2021. Similarly, a group of 06 Ph. D scholars was taken to visit a Museum and Repository of Zoological Survey of India at Solan on 20.05.2022.





### **Exposure visits to Watermill Technology at Kheri**

As much as 14 M.Sc. Physics, Ph.D. Physics, B.Sc. (Non-Medical) & B.Sc. (Hons.) Mathematics students were taken to visit the functioning of Rural Gharat (Watermill) Technology, nearby Kheri on 23.04.2022 to explore some new innovative ideas among the students related to the same. On 28.06.2022, a group of 05 M.Sc. Physics & Ph.D. Physics students of the Department of Physics were taken to know about “Prakti Air” installed in traditional stoves nearby Eternal University in order to explore some new innovative ideas among the students related to the same.



### **Excursion Trip to Mist n Meadows**

One day excursion trip for 11 students of economics was organized by two lady faculty to a nearby resort named Mist n Meadows, Rajgarh by the Department of Economics on 4th December, 2021. The trip gave students a refreshing, enlightening and tremendous learning experience through visit to a beautiful and well managed resort in such a backward area. Everyone enjoyed dancing, singing and playing indoor games.



### **Educational Tour to Shimla**

Another one-day educational tour was organized for the students of commerce & management by the Department of Commerce & Management to Shimla on 4<sup>th</sup> March, 2022. During the trip, the students visited various tourist places like Mall Road, Hanuman temple, Jakhu, Lakkar Bazar, Tibetan market etc. Students also acquired knowledge about different historical monuments made during British period. Students also learned about the commerce & trade related strategies adopted by renowned entrepreneurs in the market.



### **Introduction to Peri-operative Nursing**

One day event was organized by the Akal College of Nursing & Drexel University on 08.10.2021. Dr. Jacqueline Phaneuf, Drexel University, USA was the key person. In this event three faculty & 15 M.Sc. (N) 2<sup>nd</sup> year 2020-2022 students were the participants.

### **Voices from the Next Generation Seeking Climate Solutions**

One day event was organized by the Akal College of Nursing & Drexel University on 14.10.2021. Ms. Muskan, M.Sc. (N) 2<sup>nd</sup> year & Ms. Stakshi 4<sup>th</sup> year B.Sc.(N) were organizers. In this event ACN students participated as Panel members.

### **Breast Feeding: Getting Mother and Baby Started**

One day programme was organized by the Akal College of Nursing & Drexel University on 15.10.2021. Dr. Karen Lafferty was the chief guest. In this event three faculty & 15 M.Sc. (N) 2<sup>nd</sup> year 2020-2022 students were the participants.



## Free Health Checkup and Medical Camp

As a part of Eternal University Sustainable Development Outreach Activities SDG Goal 3: Good Health and Well Being Akal College of Health and Allied Sciences celebrated World Health Day 2022 “Our Planet, Our Health” on 1st April to 6<sup>th</sup> April 2022. Health Camp was organized at 7 adopted Villages of Department of Community health Nursing, Akal College of Nursing, Eternal University such as Bagroti, Neri Navan, Chunnar, Jabiyana, Machher, Bongli Kech, Lana Mue and Riwadla. During the Program General Health Check-up, the following was carried out by the students under the guidance of faculty: BP Monitoring, Random Blood Sugar, Haemoglobin estimation, BMI Checking, Mobile Exhibition with propaganda, Pamphlet distribution, Mass Awareness Program.



## Pediatric Enteric Feeding

One day event was organized by the Akal College of Nursing & Drexel University on 15.04.2022. Dr. Kathleen Healy, Drexel University, USA was the main key speaker. In this event fifteen M.Sc. (N) 2nd year & 58 B.Sc. (N) 3rd year students were the participants.

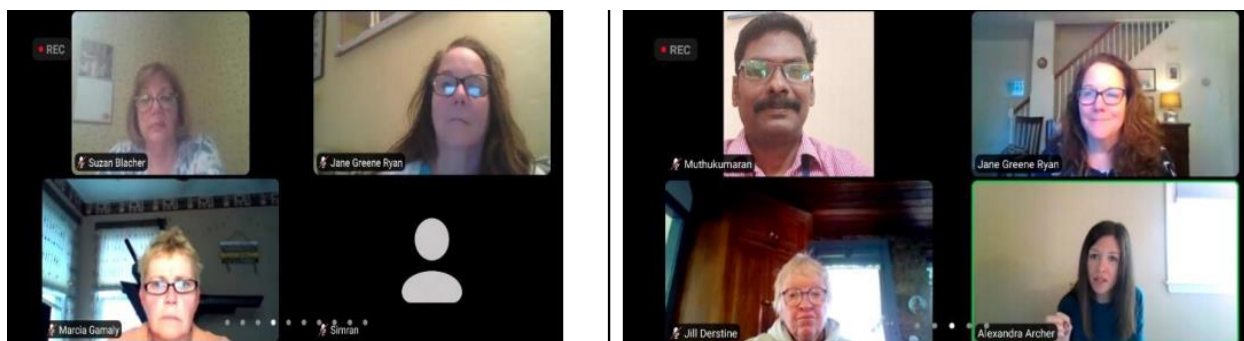


**Addictions:** One day programme was organized by the Akal College of Nursing & Drexel University on 23.04.2022. Dr. Jacqueline Phaneuf, Drexel University, USA was the main organizer. In this event, fifteen M.Sc. (N) 2nd year & 58 B.Sc. (N) 3rd year students were the participants.



**Assertiveness & Self-Care:** One day event was organized by the Akal College of Nursing & Drexel University on 29.04.2022. Dr. Gloria Donnelly, Drexel University, USA was the main organizer. In this event, fifteen M.Sc. (N) 2nd year & 58 B.Sc. (N) 3rd year students were the participants.

**Nurse Communication:** One day event was organized by the Akal College of Nursing & Drexel University on 06.05.2022. Dr. Suzan Blacher, Drexel University, USA was the main organizer. In this event, fifteen M.Sc. (N) 2nd year & 58 B.Sc. (N) 3rd year students were the participants.



**Community Demonstration On Nutritious Food For Malnourished Children & Pregnant Mother:** As a part of Eternal University Sustainable Development Outreach Activities SDG Goal 3: Good Health and Well Being Akal College of Health and Allied Sciences Organized Nutrition Exhibition on 17th May 2022 at Kerry, Lana Balta, and Bonglikhech Villages regarding Health Food Habits with Cooking Demonstration to the households. Village People were participated enthusiastically, and 150 members were got benefited through this programme



especially women were involved more. The program was much appreciated by everyone who witnessed the event, and it was effective, doubts raised by the public were cleared.



**World Breast Feeding Week:** Akal College of Health and Allied Sciences, Eternal University, orchestrated a dynamic World Breastfeeding event during 1<sup>st</sup> week of August, 2022. The event received global recognition and appreciation from the World Alliance for Breastfeeding Action (WABA) in Malaysia. The program, aimed at promoting breastfeeding awareness and education, resonated across communities, leaving a positive impact benefiting over 1000 individuals in eleven adopted villages.



Education of mother at household level



Awareness at community level

**Fresher's Welcome:** Every student eagerly awaits right from their time of admission for their remarkable event of college "Fresher's Party. The 20<sup>th</sup> November, 2022 was the memorable day in the life of every fresher of academic 2022-23 batch at Eternal University. The Fresher day was filled with excitement, joy, music, enthusiasm, laughter and happiness. It is day where senior and junior finally bond and unite to celebrate being part of the college. Students of First Year (batch:

2022-23) were welcomed by the seniors. The celebration kick started at 12:00 pm by Ribbon cutting and welcomed with “Tilak” in the Auditorium of the University. Programme proceeded with different cultural activities. The celebration concluded with the fresher students receiving titles such as Miss Fresher, Miss Eve, and Miss Versatile based on the talents.



### NCC Training Camps

The NCC is optional for the students of the undergraduate programs. Every enrolled student in NCC, is required to undergo two years training during bachelor’s degree program. An annual NCC Training Camp was held from 10-17 December 2022 at Eternal University Baru Sahib by the 1HP Girls Battalion NCC under the aegis of NCC Group Headquarters Shimla. The aim of camp was to impart multidisciplinary training including Drills, Weapon training, Map reading, Field Craft, Battle craft, Physical fitness, Sports activities, Yoga, Social service and Community Development to the cadets for talent and holistic development. The cadets also benefitted by understanding time management, self- discipline and selfless service to the nation and leadership traits. During the year under report 16 cadets received BEE and 24 cadets CEE certificates.





## **Kisan Mela**

Kisan Mela was organized by Eternal University, Baru Sahib on 12<sup>th</sup> and 13<sup>th</sup> April, 2023 for the benefit of farming community of Sirmour district. In this Kisan Mela about 500 farmers from the surrounding areas participated in this event. The Kisan Mela was inaugurated on 12/04/2023 by chief guest Dr. S.K. Malhotra, Director ICAR-Directorate of Knowledge Management in Agriculture, New Delhi in the presence of Baba (Dr.) Davinder Singh Ji, Honourable President Kalgidhar Trust and Chancellor of Eternal University. Dr. S.K. Malhotra, appreciated the technologies developed by the university for the benefit of farmers and highlighted the role of millets in sustaining agriculture productivity. Honourable Baba (Dr.) Davinder Singh Ji in his address appealed to the faculty members to concentrate on need-based research projects depending upon local needs and close interaction with the farmers. During the inaugural function Sh. Arjun Attri was awarded with Padmashri Sardar Jagjit Singh Hara Excellent Progressive cum Innovative Farmer Award along with Gold Medal, Citation and a cash prize. Mrs. Sunita Sharma of Shillai was awarded with appreciation certificate along with cash prize of Rs. 3100/-. Dr. S.K. Malhotra inaugurated the exhibition put up by the university along with other dignitaries and visited different stalls put up by different departments of the university and line departments of the state government and the private seed companies. In this Kisan Mela 45 stalls were put up by different departments of university and government departments. The stall of Department of Genetics Plant Breeding and Biotechnology was adjudged the best followed by AC ECM. Sh. Nagender Chauhan Village Chaloga Byas was awarded with appreciation certificate along with cash prize on the valedictory day for his outstanding contributions by the Pro Vice Chancellor.



**Chief Guest of the Kisan Mela inaugurating agricultural exhibition**

**Chief Guest interacting with faculty and students**

## **Free Medical Camp**

A two-day free medical and surgical camp was organized by Akal Charitable Hospital and Akal College of Nursing under the auspices of The Kalgidhar Society on the 21st and 22nd of April, 2023. This initiative marked the hospital's 102nd camp, solidifying its commitment to providing



free healthcare services to the marginalized population in the Sirmaur district. With the blessings of Revered Saint-Sant Baba Iqbal Singh Ji, and under the guidance of Honorable Baba Dr. Davinder Singh Ji and Dr. Neelam Kaur Mam Ji, the camp aimed to reach rural, underserved communities and offer comprehensive medical assistance.



### **Alumni Meet**

Akal College of Nursing, Eternal University added another milestone in the activities by starting Alumni Talk Series. **1<sup>st</sup> Alumni Talk Series** was Organized on 05.04.2023. **Ms. Amanpreet Kaur, 2008 – 2012 (1st Batch) and presently** Registered Nurse in Emergency Department, Saint John of God Midland Hospital, Perth, Western Australia shared her views and experiences over her journey from Baru Sahib to Australia with faculty, students and Alumni of EU. The questions and doubts asked by the students and Alumni were cleared by addressed. The **2<sup>nd</sup> Alumni Talk Series** was Organized on 09.04.2023. In this Ms Anjali (2015-2019) batch and presently Registered Mental Health Nurse cum Nursing Associate in Hayes Cottage Nursing Home Hayes UB3 2RR, UK shared her achievements.



## Educational tour to ICAR-Directorate of Mushroom Research, Solan

Department of Microbiology organized educational visit to ICAR-Directorate of Mushroom Research on 15<sup>th</sup> March 2019. Accompanied by Dr. Nasib Singh and Dr. Poonam Sharma, the students visited mushroom museum and processing yards at DMR and interacted with the staff personnel's on various aspects of cultivable mushrooms, edible vs poisonous mushrooms, spawn/inoculum preparation, steps/processes involved in compost/beds preparation, microbiological aspects, harvesting, yields, market demands, training opportunities and setting an entrepreneurship venture based on mushroom cultivation.





## Exposure visit of B.Sc. (Hons.) Agriculture 4th-year students

An exposure visit was organized for the B.Sc. (Hons.) Agriculture 4th-year students who had opted for Mushroom Cultivation Technology and Commercial Beekeeping as Modules for Skill Development and Entrepreneurship. The visit was scheduled on 25th April 2023 to the Maharana Pratap Horticulture University, Regional Research Centre, Murthal, Sonapat, Haryana, and on 26th April 2023, to the Integrated Bee Keeping Development Centre (Indo-Israel Agriculture Project), Ramnagar, Shahbad, Haryana. The primary objective of the visit was to provide hands-on exposure to the students in Mushroom Cultivation Technology and Commercial Beekeeping, which will help them to understand the practical aspects of these modules. The exposure visit was highly informative and beneficial for the students who had opted for Mushroom Cultivation Technology and Commercial Beekeeping as Modules for Skill Development and Entrepreneurship. Overall, the visit was a great learning experience for the students as well as the faculty members, and it is expected to motivate them to take up entrepreneurship in the mushroom cultivation and beekeeping sectors.





## Visit to the Farm of Sh. Arjun Attri

The 17<sup>th</sup> May, 2023 was marked an exciting day as our group of final-year B.Sc. (Hons.) Agriculture students embarked on an exposure visit to the renowned farm of Sh. Arjun Attri in the beautiful village of Parara. Accompanied by Dr Yogeeta Thakur, and Dr Praneet Chauhan. The purpose was to learn about innovative farming techniques and witness firsthand the success story of Sh. Arjun Attri. The farm was spread across 6 bighas of land and was a perfect blend of traditional farming practices and modern technologies. Students saw fields of HDP of apples and a variety of vegetables along with coriander, chickpea, garlic and black gram multi-cropped in the apple orchard.. It was inspiring to see how farmer had implemented sustainable practices to ensure the long-term health of his land. One of the highlights of the visit was the demonstration of the advanced irrigation system used on the farm. Sh. Arjun Attri had installed drip irrigation and sprinkler systems, which not only conserved water but also ensured precise watering for each crop. He explained the importance of honeybees in pollination and additional income through this activity.



**Farewell Function:** The auditorium of Eternal University echoed with the blessings on the morning of 20 May, 2023, when students of eternal university came together to bid farewell to the outgoing batch 2019-20. The day was a fiesta devoted to the years spent together with friends and teachers to reminisce joyous moments. Hence juniors expressed their appreciation and wished their seniors well on their future endeavors & seniors were welcomed by stage organized with a promise for making a day memorable. The celebration started by cake cutting. After that, they performed various activities like singing, dancing, motivational speeches, games etc. Then, Miss. farewell, Miss. personality Miss. Eve and Miss. Versatile title were given to the senior's students by juniors. Since every ending herald a fresh start, the event was wrapped up with group photos and scrapbooking.



### Annual Sports Meet

Eternal University, Baru Sahib, organized Annual Sports Meet on 10<sup>th</sup> June, 2023 in the University Playground. The students of seven colleges participated in different events. Hon'ble Vice Chancellor, Dr. Davinder Singh ji was Chief Guest of the Day. He joined the event and motivated the students to participate in athletics. More than 100 students participated in various events of Annual Sports Meet and total gathering was more than 500 students & faculty. At the end Prize Distribution Ceremony was organized for the winners.



**Training of B. Sc. Agri. (Hons.) students under Rural Agriculture Work Experience (RAWE):**

**No.UHF/DEE/RAWE/  
Dr. YS Parmar University of Horticulture & Forestry, Nauni, Solan, HP – 173 230  
Directorate of Extension Education**

**No.UHF/DEE/RAWE/2023{-3959-  
Dated: 06.09.2023**

**Subject: Training of Eternal University Students of B.Sc. Agri. (Hons.) under Rural Agriculture Work Experience w.e.f. 10-24 Sept., 2023 at UHF, Nauni - regarding.**

This has reference to letter No.EU/DKSGACA/RAWE/18 dated 05<sup>th</sup> August, 2023 received from the Dean, College of Agriculture, Eternal University, Baru Sahib on the above mentioned subject. Accordingly, the training programme of Eternal University Students (22 No.) of B.Sc. Agri. (Hons.) w.e.f. 10-24 Sept., 2023 at UHF, Nauni has been fixed.

In this context, you are requested to direct the scientists who will acquaint the students of RAWE training with the practical activities of your respective department (at the B.Sc. Final Year level) as per the schedule given below.

Dr. P K Baweja, Principal Scientist (Agromet) of this Directorate will coordinate the programme. Further, any communication regarding the said training, contact at her mobile **96257-22255**.

*The plan of visit-cum-training in different departments is as follows:*

S.No.	Date	Department
<b>I. College of Horticulture</b>		
1.	11 Sept., 2023	Department of FRUIT SCIENCE
2.	12 Sept., 2023	Department of VEGETABLE SCIENCE
3.	13 Sept., 2023	Department of PLANT PATHOLOGY
4.	14 Sept., 2023	Department of BIOTECHNOLOGY
5.	15 Sept., 2023	Department of FLORICULTURE & LANDSCAPE ARCH.
6.	16 Sept., 2023	Department of FOOD SCIENCE & TECH.
8.	18 Sept., 2023	Department of SEED SCIENCE
9.	19 Sept., 2023	Department of ENTOMOLOGY
<b>II. College of Forestry</b>		
10.	20 Sept., 2023	Department of SOIL SCIENCE & WM
11.	21 Sept., 2023	Department of SILVICULTURE & AGRO-FORESTRY
12.	22 Sept., 2023(FN)	Department of FOREST PRODUCTS
13.	22 Sept., 2023(AN)	Department of ENVIRONMENTAL SCIENCE
<b>III. Director of Extension Education</b>		
14.	23 Sept., 2023	DIRECTORATE of EXTENSION EDUCATION



THE BATCH WILL COMMENCE AT 10.15 A.M TILL 1.30 NOON AND  
RESUME AT 2.15 P.M. TILL 4.45 P.M.

  
Director 6/9/2023  
Extension Education

1. Prof. & Head,  
Dept. of Fruit Science / Vegetable Science / Seed Science & Technology/  
Floriculture & Landscape Architecture/ Food Science & Technology / Plant  
Pathology / Entomology/ Biotechnology **College of Horticulture**
2. The Prof. & Head,  
Dept. of SAF /Soil Science / Forest Product / Environmental Science  
College of Forestry  
  
Dr YSP UHF, Nauri-Solan

Copy to the following for information & necessary action:

1. Dean, College of Agriculture, Eternal University, Baru Sahib, Via Rajgarh,  
Distt. Sirmour, HP – 173101.
2. Dean, College of Horticulture / College of Forestry, Dr. YSP UHF, Nauri,  
Solan.
3. Joint Director (Training), Directorate of Extension Education, Dr YSP UHF,  
Nauri-Solan.
4. Dr. P K Baweja, Principal Scientist (Agromet), Directorate of Extension  
Education, Dr YSP UHF, Nauri-Solan.

  
Director  
Extension Education

# Research paper publications by Students in reputed journals:



## OPEN ACCESS

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## Prevalence of antibiotic-resistant Gram-negative bacteria having extended-spectrum $\beta$ -lactamase phenotypes in polluted irrigation-purpose wastewaters from Indian agro-ecosystems



Achhada Ujalkaur Avatsingh<sup>1</sup>, Shilpa Sharma<sup>1</sup>, Shilppreet Kour<sup>1</sup>,  
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Antibiotic resistance in bacteria has emerged as a serious public health threat worldwide. Aquatic environments including irrigation-purpose wastewaters facilitate the emergence and transmission of antibiotic-resistant bacteria and antibiotic resistance genes leading to detrimental effects on human health and environment sustainability. Considering the paramount threat of ever-increasing antibiotic resistance to human health, there is an urgent need for continuous environmental monitoring of antibiotic-resistant bacteria and antibiotic resistance genes in wastewater being used for irrigation in Indian agro-ecosystems. In this study, the prevalence of antibiotic resistance in Gram-negative bacteria isolated from irrigation-purpose wastewater samples from Sirmour and Solan districts of Himachal Pradesh was determined. Bacterial isolates of genera *Escherichia*, *Enterobacter*, *Hafnia*, *Shigella*, *Citrobacter*, and *Klebsiella* obtained from 11 different geographical locations were found to exhibit resistance against ampicillin, amoxycylav, cefotaxime, co-trimoxazole, tobramycin, cefpodoxime and ceftazidime. However, all the isolates were sensitive to aminoglycoside antibiotic gentamicin. *Enterobacter*spp. and *Escherichia coli* showed predominance among all the isolates. Multidrug-resistance phenotype was observed with isolate AUK-06 (*Enterobacter* sp.) which exhibited resistant to five antibiotics. Isolate AUK-02 and AUK-09, both *E. coli* strains showed resistant phenotypes to four antibiotics each. Phenotypic detection revealed that six isolates were positive for extended-spectrum  $\beta$ -lactamases which includes two isolates from *Enterobacter*spp. and *E. coli* each and one each from *Shigella* sp. and *Citrobacter* sp. Overall, the findings revealed the occurrence of antibiotic resistant and ESBL-positive bacterial isolates in wastewaters utilized for irrigation purpose in the study area and necessitate continuous monitoring and precautionary interventions. The outcomes of the study would be of significant clinical, epidemiological, and agro-environmental importance in designing effective wastewater management and environmental pollution control strategies.

## Article

# Gastrointestinal Nematodes and Protozoa in Small and Large Ruminants from Rural Agro-Climatic Regions of Northern India

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**Abstract:** Gastrointestinal nematode parasites and gastrointestinal protozoan parasites are considered detrimental to the livestock population and manifest production-limiting effects. Small and large ruminants (cattle, buffalo, goats, and sheep) are important components of the rural economy of northern India. However, the epidemiology of gastrointestinal parasites in this agro-climatic region has not been studied extensively. In this study, the prevalence of gastrointestinal parasites was determined in 163 animals, including cattle ( $n = 86$ ), buffalo ( $n = 11$ ), goats ( $n = 48$ ), and sheep ( $n = 18$ ) from 26 sampling sites by copro-parasitological analysis. The prevalence values of 94.47% and 66.87% were recorded for the nematodes and protozoa, respectively. The group-wise prevalence of gastrointestinal nematode parasites was 95.3%, 90.9%, 93.7%, and 94.4% in cattle, buffalo, goats, and sheep, respectively, whereas for gastrointestinal protozoan parasites, the respective values were 70.9%, 54.5%, 60.4%, and 72.2%. Copromicroscopy revealed ten genera of nematodes—*Ascaris*, *Capillaria*, *Cooperia*, *Haemonchus*, *Nematodirus*, *Oesophagostomum*, *Ostertagia*, *Strongyloides*, *Trichostrongylus*, *Trichuris*, and one protozoan genus—*Eimeria*. The prevalence of *Trichostrongylus* spp. was highest in buffaloes, whereas in cattle, *Ascaris* spp. were predominant. In both goats and sheep, *Haemonchus contortus* was found to be predominant. The highest prevalence of gastrointestinal parasites was recorded in the rainy season. These findings indicate the prevalence of gastrointestinal parasites in the ruminant population in this region and necessitate the implementation of preventive and control strategies for effective animal health management.

**Keywords:** helminth parasites; ruminants; livestock; gastrointestinal nematode parasites; gastrointestinal protozoan parasites

## 1. Introduction

Livestock farming remains the backbone of the rural economy in India [1–3]. It is recognized as the most important sub-sector of Indian agriculture and supports the basic needs and income of rural households in most parts of the country especially of northern hilly states [2,4–7]. According to the 20th Livestock Census 2019 report, the total livestock population in India is 536.76 million, of which 95.78% are from rural areas of the country [8]. The total number of cattle, buffaloes, goats, and sheep is 193.46 million, 109.85 million, 148.88 million, and 74.26 million which represent 36.04%, 20.47%, 27.74% and 13.83% of the total livestock population, respectively [8]. In Himachal Pradesh, the total livestock population is 4.41 million and constitutes an essential component of the livelihood of the rural population [8].





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# Prokaryotic diversity and community structure in the rhizosphere of Lantana weed (*Lantana camara* L.)

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Lantana weed (*Lantana camara* L.) is among the most noxious weeds in the world. Keeping in mind its invasive behavior and great ecological tolerance, it becomes imperative to analyze the structure and function of associated microbiome. In this perspective, Illumina-based metagenome sequencing was performed to gain a better understanding of prokaryotic diversity and community structure in the rhizosphere soil of *L. camara* L. The organic carbon, nitrogen, phosphorus, and potassium contents in the rhizosphere soil were 0.91% ( $\pm$  0.21%); 280 Kg ha<sup>-1</sup> ( $\pm$  4.02 Kg ha<sup>-1</sup>), 54.5 Kg ha<sup>-1</sup> ( $\pm$  3.12 Kg ha<sup>-1</sup>), and 189 Kg ha<sup>-1</sup> ( $\pm$  6.11 Kg ha<sup>-1</sup>), respectively. The metagenome analysis revealed the existence of 41 bacterial and 2 archaeal phyla, with only 12 showing  $\geq$ 1% abundances. Pseudomonadota was the dominant phylum with 31.3% abundance, followed by Actinomycetota (20.9%). Further, 54 different genera were identified with the highest abundance of *Devosia* (2.8%). The PICRUSt analysis predicted various functional traits in the soil metagenome, with general cellular functions dominating, followed by stress tolerance. Moreover, 10% of the functions were associated with nitrogen fixation, phosphate solubilization, and potassium mobilization. In conclusion, the present study revealed the existence of diverse prokaryotic communities in the rhizosphere of the *L. camara* L. which was primarily associated with stress response and plant growth promotion. To the best of our knowledge, this study documents for the first time the *L. camara* L. microbiome. Furthermore, the identified genera can be explored for agricultural needs in future.

## KEYWORDS

Illumina HiSeqX, PICRUSt analysis, bacterial diversity, metagenomics, weed plants



## Effect of Processing Treatments on the Nutritional, Anti-Nutritional, and Bioactive Composition of Blue Maize (*Zea Mays* L.)

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### Abstract

Maize is considered as an important annual cereal crop cultivated widely throughout the world. Blue Maize (*Zea mays* L.) is a blue-colored variety of maize containing high content of anthocyanin and belongs to the family Poaceae. The current study aimed to evaluate the effect of soaking, germination, natural fermentation, and roasting on nutritional, anti-nutritional, and bioactive components of blue maize. The changes in chemical composition were studied after 12 and 24 h of soaking and 24, 48, and 72 h of germination treatment. The blue maize grains were subjected to natural fermentation for time intervals of 12, 24, and 36 h, and roasting treatment by heating at 180 °C on a hot plate for 10 s. The results revealed that the phenolic content increased significantly ( $p \leq 0.05$ ) from 44.88 to 51.56 mg GAE/100g after 36 h fermentation and from 44.88 to 61.05 mg GAE/100g after 72 h of germination whereas it decreased from 44.88 to 35.73 mg GAE/100g during the roasting process. Further, there was a 44.02 and 20.22% increase in protein content during germination and fermentation processes, respectively, and a slight decrease of 2.16% after roasting treatment. The antioxidant activity increased significantly ( $p \leq 0.05$ ) from 10.41 to 18.85% during germination and 10.41 to 14.50% during fermentation, respectively. But it was found to get decreased by 6.53% after the roasting process. The anti-nutrients such as phytic acid and tannins declined significantly ( $p \leq 0.05$ ) during the processing treatments.



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Blue Maize;  
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Germination; Roasting.

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RESEARCH ARTICLE

# Effect of processing treatments on nutritional, anti-nutritional and bioactive characteristics of horse gram (*Macrotyloma uniflorum* L.)

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## ABSTRACT

Horse gram (*Macrotyloma uniflorum* L.) is an important and one of the most nutritious crops that can be utilized as a basic ingredient for the preparation of several foods because of its high nutritional value. Cereal sprouts are supposed to have a better nutritional profile than cereal grains and their products. The present study aimed to explore the changes occurring during the processing treatments such as soaking and germination of horse gram seeds. The effect of processing treatments on nutritional, anti-nutritional, minerals (Fe, Zn, Mn, and Cu), and bioactive components of horse gram was studied at an interval of 12 and 24 h during soaking and 24, 48, and 72 h during the germination treatment. The results revealed that there was a 20.66 and 23.01% rise in protein content during soaking and germination treatments, respectively. The phenolic components were enhanced to 28.49% and antioxidant activity increased by 31.51% respectively after soaking and germination treatments. The anti-nutritional components like phytic acid, trypsin inhibitor, and tannin contents decreased significantly ( $p \leq 0.05$ ) to 40.50, 28.57, and 26.79%, respectively after 72 h of germination. The mineral contents of horse gram increased significantly after soaking and germination processing treatments.

**Keywords:** Anti-nutrients, bioactive components, germination, horse gram, soaking

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## INTRODUCTION

India is considered as the top producer and consumer of pulses in the world. Pulses should be incorporated into the diet as it is an important source of protein for vegetarian people. Underutilized pulses are a valuable food source with numerous nutritional and health benefits for consumers and contribute effectively to global and regional food security. Among various

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# Impact of soaking, germination, fermentation, and roasting treatments on nutritional, anti-nutritional, and bioactive composition of black soybean (*Glycine max* L.)

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## ABSTRACT

Legumes are plants of the family *Leguminosae* with seed pods that split into two halves. Black soybean seed coat contains numerous bioactive compounds having radical scavenging, anti-tumor, and anti-carcinogenic activities. This study was aimed to assess the effect of soaking, germination, natural fermentation, and roasting on nutritional and anti-nutritional components, minerals (Fe, Zn, Mn, and Cu), and bioactive components of the black soybean. The effect of soaking was studied at 12 and 24 h while that of germination at 24, 48, and 72 h. The results revealed that the phenolic contents augmented significantly ( $P \leq 0.05$ ) in germination, fermentation, and roasting by 11.49%, 8.96%, 2.95%. Further, there was an 11.84% and 22.13% increase in the protein contents during the germination and fermentation processes, respectively. The antioxidant activity of processed grains increased significantly ( $P \leq 0.05$ ) during germination, fermentation, and roasting by 72.51, 10.14, and 9.64%, respectively. The anti-nutritional compounds such as phytic acid and tannin contents decreased significantly ( $P \leq 0.05$ ) during processing treatments. Phytic acid decreased to the extent of 34.04, 51.06, and 13.47% and tannin contents as 47.22, 75, and 38.89%, after germination, fermentation, and roasting processes, respectively. A significant ( $P \leq 0.05$ ) increase in mineral contents was observed after the germination, fermentation, and roasting of the black soybean.

## 1. INTRODUCTION

There is great importance of pulses in human nutrition as these provide a sufficient amount of proteins, calories, vitamins, minerals, and other bioactive components [1]. The popularity of soybean is growing at faster rate as these are rich sources of micronutrients such as Fe, Zn, and Ca and have low glycemic index. The production of soybean showed increasing trend from 454.50 kg/ha in 1961 to 927.80 kg/ha in 2020 in India. The overall production of soybean in world was 385.85 million metric tonnes during 2019–2020 [2]. Besides nutraceutical components, seed comprises numerous essential isoflavones, namely, daidzein and genistein having medicinal properties [3]. The soybean seed coat is rich in several bioactive components having radical scavenging, anti-tumor, and anti-carcinogenic activity [4]. It is nutritionally rich and comprises higher contents of carbohydrates (30%), proteins (32.1–39.8%), fats (10.8–19.6%), dietary fibers (21.77–30.31%), and minerals (3.93–6.15%) including phosphorous,

iron, potassium, sodium, zinc, copper, and manganese. Besides, higher content of vitamin B comprising vitamin B1, B2, B3, B5, and B6 is present in different cultivars of soybean [5].

Black soybean (*Glycine max* L. Merrill) has recently received considerable attention due to its high nutritional value and availability as an ingredient in various foods and folk medicines in Asia. Out of the supposed medicinal components in black soybean, the common chemical components are anthocyanins [6], isoflavones such as phytoestrogens [7], oligosaccharides, and saponins [7]. Soybean contains anti-nutritional factors such as tannin and phytic acid. These anti-nutritional factors, especially phytates, are powerful chelating agents that reduce the bioavailability of divalent cations such as zinc, iron, and calcium by the formation of insoluble phytates [8].

Traditional processing treatments such as soaking, fermenting, germinating, and roasting have been utilized for improving the nutritional value of cereals and pulses [9]. The germination process is widely used in cereals and legumes for increasing the nutritive value mainly through the breakdown of anti-nutritional components [10]. Processing techniques responsible for decreasing the anti-nutritional factors as well as minimizing the losses of micronutrients are of great interest to scientists. The thermal, as well as biological processing

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# Influence of soaking and germination treatments on the nutritional, anti-nutritional, and bioactive composition of pigeon pea (*Cajanus cajan* L.)

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## ABSTRACT

Pigeon pea (*Cajanus cajan* L.) is an important perennial pulse from the family Fabaceae. It is one of the important underutilized pulses having high nutritional value and can be used as a basic ingredient for the preparation of value-added food products. The present investigation aimed to study the influence of soaking and germination on nutritional and anti-nutritional components, minerals (Fe, Zn, Mn, and Cu), and bioactive components of pigeon pea grains. The effect of soaking was studied at 12 and 24 h while that of germination at 24, 48, and 72 h. The results revealed that there was a 6.34% and 15.41% increase in protein contents during soaking and germination treatments, respectively. A significant ( $P \leq 0.05$ ) increase in reducing power (91.46%) and metal chelating activity (64.16%) was observed in germinated pigeon pea. The phenolic components and antioxidant activity increased by 5.34 and 76.15% after 72 h of germination, respectively, but the anti-nutritional components like tannin contents and the phytic acids decreased significantly ( $P \leq 0.05$ ) by 57.97 and 63.05%, respectively after 72 h of germination. A significant ( $P \leq 0.05$ ) increase in mineral contents was observed after the soaking and germination treatments of pigeon pea grains. Therefore the soaking and germination processing of pigeon pea grains resulted in enhancing the nutritive value and bioactive potential with a reduction in anti-nutritional compounds.

## 1. INTRODUCTION

Pulses are the potential sources of vegetable proteins in the human diet. India is the world's leading producer of pulses. It is cultivated in several parts of the world and does not require much water as it is considered a drought-resistant crop. These have a protein level of 20–25% by weight, which is twice that of wheat and three times that of rice. Pigeon pea (*Cajanus cajan* L.) is extensively utilized in the form of a pulse and is considered an inexpensive source of proteins. Besides, it is a vital source of nutraceutical and bioactive components. The bioactive components of pigeon pea were examined for their role in increasing the anti-carcinogenic and antioxidant effects, as well as these, have been reported to play a crucial role in modulating the gut microbiota [1]. It is a great source of B-complex vitamins, carbohydrates, and minerals. Pigeon pea when supplemented with other cereals provides a well-balanced diet with all essential amino acids and is equivalent to other protein-rich sources such as soybean

and whey [2]. Due to the existence of various flavonoids and polyphenolic compounds in pigeon pea, it has several nutraceutical characteristics in addition to its high nutritional value. Several studies have shown that consuming pigeon pea reduces the risk of various lifestyle diseases such as diabetes, obesity, cancer, and cardiovascular disorders [3]. Pigeon pea is a dense source of nutrients, but some anti-nutrients such as phytic acid, tannins, and trypsin inhibitors bind with its nutritional elements making them unavailable to our body. Phytic acid binds with dietary minerals, such as iron, calcium, zinc, etc., tannins bind with proteins preventing their absorption, and trypsin inhibitors bind with the enzyme trypsin, thereby reducing its biological activity. Soaking is a conventional method used for hydrating the grains in the water [4] and proved useful for the reduction as well as the elimination of the anti-nutrients existing in the food grains [5]. It has been reported from various studies that soaking of food grains for 12–18 h is the best effective processing treatment to decrease the level of anti-nutrients such as trypsin inhibitors, phytic acid, etc. which are wholly or partially soluble in water [4,6]. Germination is a commonly used conventional technique that enhances the digestibility of nutrients, improves bioactive components, and reduces some anti-nutritional components in pulses. It also enhances the concentration of bioactive compounds such as total phenolic components, reducing

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## Effect of soaking and germination treatments on nutritional, anti-nutritional, and bioactive properties of amaranth (*Amaranthus hypochondriacus* L.), quinoa (*Chenopodium quinoa* L.), and buckwheat (*Fagopyrum esculentum* L.)

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### ABSTRACT

Pseudocereals have attracted the attention of nutritionists and food technologists due to their high nutritional value. In addition to their richness in nutritional and bioactive components, these are deficient in gluten and can serve as valuable food for persons suffering from gluten allergies. Processing treatments are considered an effective way to enhance the quality of food grains. Soaking and germination are traditional and most effective treatments for enhancing the nutritional and bioactive potential as well as reducing the anti-nutritional components in food grains. This study reflects the effect of soaking and germination treatments on nutritional, bioactive, and anti-nutritional characteristics of pseudocereals. There was a significant ( $p \leq 0.05$ ) increase in nutritional and bioactive components such as crude fiber, crude protein, phenolic components, antioxidant activity, and mineral content but reduced the anti-nutrients such as tannin and phytic acid. In amaranth, there was a significant increase ( $p \leq 0.05$ ) of 7.01, 74.67, 126.62, and 87.47% in crude protein, crude fiber, phenolic content, and antioxidant activity but significant ( $p \leq 0.05$ ) reduction of 32.30% and 29.57% in tannin and phytic acid contents, respectively. Similar changes in values of crude proteins, crude fiber, phenolic content, and antioxidant activity were observed in buckwheat and quinoa. While the anti-nutritional components such as tannin and phytic acid decreased by 59.91 and 17.42%, in buckwheat and 27.08% and 47.57%, in quinoa, respectively. Therefore, soaking and germination proved to be excellent techniques to minimize the anti-nutritional component and enhance the nutritional, bioactive, and antioxidant potential of these underutilized grains.

### 1. Introduction

Pseudocereals are dicotyledonous gluten-free grains and are considered as a substitute to true cereals. Amaranth (*Amaranthus hypochondriacus*; family Amaranthaceae), buckwheat (*Fagopyrum esculentum*; family Polygonaceae), and quinoa (*Chenopodium quinoa* sub sp. quinoa; family Chenopodiaceae) are well-known pseudocereals used extensively worldwide. Due to their high starch content, pseudocereals can be used like other cereals for the preparation of value-added food products (Li and Zhang, 2001; Thakur et al., 2021). Recently, pseudocereals have

gained wide popularity among consumers because of their good quality proteins and their appropriateness for celiac patients. Moreover, these are also rich in dietary fiber and phenolic components, which are connected with their wide health benefits. Reports from various studies have shown that the flour of pseudocereals can be replaced with that of cereal for the preparation of functional and gluten-free food products (Alencar and de Carvalho Oliveira, 2019).

Despite being highly nutritious, these grains have limited bioavailability owing to the presence of anti-nutritional components such as tannins and phytic acid that bind with nutrients making them

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## Investigation on Conductance, Acoustical and Refractive Index Behavior of Stearalkonium Chloride in Methanol at 301 K

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### Abstract


Stearalkonium chloride (SAC) ultrasonic velocity has been measured in methanol, at 301 K temperature. Jacobson's model has been used to evaluate adiabatic and molar compressibility, molar sound velocity, solvation number, relative association, relaxation strength and other acoustical constants. The results of ultrasonic measurements of different SAC solutions in methanol indicate that there is a significant interaction between SAC and methanol molecules in diluted solutions. The conductometric study indicates that SAC behaves as a weak electrolyte in methanol. The thermodynamic constants calculated from conductance measurements for SAC solutions in methanol depict that micellization is favored over dissociation processes. The refractive index variation with SAC solutions concentrations shows a marked change in the refractive index value at critical micelle concentrations (CMC). Data treatment of obtained ultrasonic velocity, conductance measurement and refractive index shows that there is significant interaction between SAC and methanol molecules in diluted solutions, and that SAC molecules do not aggregate appreciably below the CMC.

**Keywords:** Ultrasonic velocity, adiabatic compressibility and limiting molar conductance.

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# Multiferroic properties of Mn-substituted BiFeO<sub>3</sub>

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## ABSTRACT

To study the multiferroic behavior of BiFeO<sub>3</sub> at low concentrations of Mn as dopant, BiFe<sub>1-x</sub>Mn<sub>x</sub>O<sub>3</sub> (BFMO) at  $x = 0.01, 0.02,$  and  $0.03$  has been successfully synthesized via chemical combustion method. X-ray diffraction reveals distorted rhombohedral structure for BiFeO<sub>3</sub> and respective variation in lattice parameters. The particle size is studied with FESEM images. Wide-range frequencies are used to carry out dielectric constant and  $\tan \delta$  (loss factor) measurements. The typical behavior of BFMO samples is attributed via charge-carrier hopping mechanisms due to structural inhomogeneity and formation of vacancies. The hysteresis loop measurements are used to study the ferroelectric and magnetic response. The canting of spin moments and cation–anion–cation exchange interactions leads to observed room-temperature ferromagnetism, while ferroelectric performance enhances with increasing Mn doping in BiFeO<sub>3</sub>. The altered ferroelectric and magnetic properties along with possible magnetoelectric coupling would make BFMO as suitable candidate for magnetoelectric devices. The maximum value obtained for  $\alpha_{ME}$  is  $29.03 \text{ mV cm}^{-1}\text{Oe}^{-1}$  at  $H_{dc} = 1.4 \text{ kOe}$  and could be attributed due to strong antiferromagnetic character of BFO with Mn doping.

## 1 Introduction


Coupled materials such as multiferroic materials have gained significant research attention from the past few decades due to their remarkable applications in information storage, multistate memories, actuators, transducers, sensors, electrically controlled magnetic devices, and spintronic devices [1, 2]. These materials exhibit two or more ferroic-order parameters (ferroelectricity, (anti-) ferromagnetism, and ferroelasticity) in the same phase [3]. Among the

multiferroics studied so far, bismuth ferrite (BiFeO<sub>3</sub>) denoted as BFO has been studied extensively because of its potential room-temperature applications with Neel temperature ( $T_N \sim 643 \text{ K}$ ) and a high ferroelectric Curie temperature ( $T_C \sim 1103 \text{ K}$ ) [4]. At ambient conditions, BFO crystallizes into a rhombohedrally distorted perovskite structure having R3c space group [5]. The origin of ferroelectricity is the structural distortion by  $6s^2$  lone pair of electrons whereas the emergence of magnetism by superexchange interactions among Fe–O–Fe [6]. Despite

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## Synthesis, thermal stability and surface activity of imidazolium monomeric surfactants



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### ABSTRACT

The renewable raw material-based imidazolium cationic monomeric surfactants have been prepared and characterized by FTIR, <sup>1</sup>HNMR and TGA. The conductometric study of 3-(2-(decanoyloxy)ethyl)-1-methyl-1H-imidazol-3-ium-bromide (capric surfactant) and 3-(2-(octadecanoyloxy)ethyl)-1-methyl-1H-imidazol-3-ium-bromide (stearic surfactant) with different concentrations at 298K, 303K, 308K and 313K in ethanol; indicates that these surfactants behave as weak electrolytes. The thermodynamic parameters calculated from conductivity measurements indicate that micellization is favoured over dissociation process. The results of density and viscosity measurements have been satisfactorily explained by well-known equations with their allied parameters. The surface-active properties of capric and stearic surfactant have been measured at 298K in water and ethanol. The Gibb's adsorption isotherm confirm that derivative of surface tension with respect to natural logarithm of concentration is negative, indicating that adsorption is positive in nature i.e. surface tension of the solution is lowered by addition of surfactant molecules. The thermo-gravimetric analysis (TGA) indicates that these surfactants are thermally stable up to 370 °C. Activation energy for thermal decomposition was found to be in the range of 14.00–26.06 kJ/mol and thermal stability is more for surfactants having higher hydrocarbon chain than lower one. The information collected from conductance, density and viscosity as well as surface tension measurements has shown that there is significant interaction between surfactant molecules at certain concentration (CMC).

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## Electrochemical behavior, antimicrobial activities, and effect of temperature on micellization of imidazolium monomeric surfactants

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**Abstract:** In the present study, we herein report the conductance behavior, effect of temperature, and chain-length of two environmentally friendly imidazolium cationic capric and stearic surfactants. The conductance behavior has been carried out in aqueous solvent (H<sub>2</sub>O) at four different temperatures such as 24 °C, 29 °C, 34 °C, and 39 °C. The normal micelles were formed in an aqueous solvent and critical micelle concentration (CMC) can be estimated through conductivity parameters. The expected dependency of the CMC on the alkyl chain length of the 3-(2-(decanoyloxy)ethyl)-1-methyl-1H-imidazol-3-ium-bromide and 3-(2-(octadecanoyloxy)ethyl)-1-methyl-1H-imidazol-3-ium-bromide was demonstrated. It was observed that the graphs of molar conduct activity  $v/s$  square root were not linear, which specifies that the synthesized surfactants behave as weak electrolytes in the dilute solutions. The electrochemical characterization of capric and stearic surfactant modified SPCE was studied in 1mM K<sub>3</sub>FeCN<sub>6</sub> solution. The CS/SPCE and SS/SPCE were shown elevated sensitivity, high stability, and excellent conductivity. Moreover, the antimicrobial behaviors of the synthesized imidazolium cationic surfactants versus various microbial strains were evaluated. Results showed that capric surfactant demonstrated high antibacterial activity against *Escherichia coli* (MIC > 31.5 µg/mL).

**Key words:** Electrolytes, cationic surfactants, micellization, cyclic voltammetry and antimicrobial activity



## Structural, morphological, and magnetic properties of $\text{CoFe}_2\text{O}_4$ nano-ferrites synthesized via Co-precipitation route

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### ABSTRACT

Cobalt ferrites (CFO) NPs with strong magneto-crystalline anisotropy, high coercivity, and remarkable chemical stability have attracted much attention in the past few decades. In this research, the co-precipitation approach was used to synthesize CFO NPs (i.e. as-prepared and calcined at 400 °C). Through the use of X-ray diffraction analysis (XRD), Field emission scanning electron microscopy (FE-SEM), Energy-dispersive spectroscopy (EDS), and vibrating sample magnetometer (VSM), the structural, morphological, chemical, and magnetic properties of these CFO NPs were examined. Rietveld's refined XRD pattern confirms that both the samples crystallized into a cubic structure with space group  $Fd\bar{3}m$ . The average crystallite size was found using Williamson-plots Hall's to be 37.27 nm and 21.10 nm, respectively. To verify the stoichiometry of  $\text{CoFe}_2\text{O}_4$ , the FE-SEM was used to confirm the equiaxial shape of the particles, and the EDS was used to identify their composition. The saturation magnetization ( $M_s$ ) for as-prepared and calcined CFO NPs at room temperature was determined to be 51.80, 56.303  $\text{emug}^{-1}$  using the magnetic hysteresis loop. The coercive field ( $H_c$ ) was calculated to be 0.593, 0.421 kOe, and the remanent magnetization ( $M_r$ ) to be 15.28, 14.405  $\text{emug}^{-1}$ .  
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Selection and peer-review under responsibility of the scientific committee of the International Conference on Recent Advancements in Nanotechnology for Sustainable Development.

### 1. Introduction

Chemically stable Magnetic ceramic nanomaterials are considered dominant materials in our daily life. Magnetic nanomaterials of type  $A^2+B_2^{3+}O_4$  such as  $\text{CoFe}_2\text{O}_4$ ,  $\text{MnFe}_2\text{O}_4$ ,  $\text{NiFe}_2\text{O}_4$ ,  $\text{ZnFe}_2\text{O}_4$ , and  $\text{CuFe}_2\text{O}_4$  [1–5], are the materials under intense research over the last few decades. These materials show spinel structure and have applications in modern technological fields involving microwave devices, electronic devices [2,6], drug delivery, high-density information storage, and ferrofluids [7]. Among these spinel ferrites, Cobalt Ferrite ( $\text{CoFe}_2\text{O}_4$ ) is a well-known hard magnetic material and has attracted much attention due to its high coercivity at room temperature, high electromagnetic performance [3,8], moderate magnetization, high chemical stability, and high cubic magne-

to-crystalline anisotropy [9]. It also shows photomagnetic property (i.e. change in coercivity due to light). Owing to these properties nanoparticles are promising candidates and are utilized in various electronic devices, audio or video tape recordings, and high-density digital recording disks [10–13], and are also used as pesticides in agriculture fields [14–16].

$\text{CoFe}_2\text{O}_4$  (CFO) is a ferrimagnetic material with an inverse spinel structure, where oxygen ions occupy fcc (Face centered cubic) close packing, half of the Fe (III) ions occupy the tetrahedral A site, and the other half along with Co (II) ions are located at the octahedral B site [17]. The ferrimagnetic character is due to the antiparallel sublattices that are coupled together by superexchange interaction through  $\text{O}^{2-}$  ions.

CFO nanoparticles (NPs) are under intense research as their electrical, chemical, physical, and magnetic properties vary with the particle size, shape, and purity, which is closely related to the synthesis method. The shape, size of the particle, and distribution

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## Synthesis, self-assembly and surface-active properties of alkyl halide mediated imidazolium monomeric surfactants

Jaswinder Kaur<sup>a</sup>, Roheela Farzeen<sup>a</sup>, Anil Kumar<sup>a</sup>, Manpreet Singh<sup>b</sup>, Madan Lal<sup>c</sup>, Sanjay Kumar Upadhyaya<sup>d</sup>, and Kamal Kishore<sup>a</sup>

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<sup>b</sup>Department of Chemistry and Chemical Sciences, Central University of Jammu, Samba, Jammu and Kashmir, India; <sup>c</sup>Department of Allied Sciences (Physics), Graphic Era (to be Deemed University), Dehradun, Uttarakhand, India; <sup>d</sup>P.G. Department of Chemistry, S. S. L. Jain College, Vidisha, Madhya Pradesh, India

### ABSTRACT

Two imidazolium monomeric surfactants, that is, 1-tetradecyl-1H-imidazole [14IM] and 1-hexadecyl-1H-imidazole [16IM] has been synthesized and characterized by <sup>1</sup>H NMR, <sup>13</sup>C NMR, FTIR, HRMS spectroscopies and thermogravimetric analysis (TGA) for number and types of protons and carbon, functional groups, estimation of molecular weight and thermal stability of these compounds. The conductivity was measured in double distilled water at four different temperatures, 288, 293, 298, and 303 K. The results showed that these surfactants behave as weak electrolytes. The density and viscosity data have shown the existence of strong interactions between imidazolium surfactants and solvent (water) molecules. The results obtained from Root's equation indicate that surfactant-solvent interactions are important than surfactant-surfactant interactions in dilute solutions, that is, below critical micellar concentration. The values of constants obtained from Einstein and Moulik equations have revealed that there was stronger and significant interaction between imidazolium surfactants and water molecules below critical micellar region. The surface tension parameters have indicated that these surfactants are good contenders to lower the surface tension of air/water interface. The results obtained from surface tension data have shown that standard change in free energy of micellization ( $\Delta G^{\circ}_{mic}$ ) and adsorption ( $\Delta G^{\circ}_{ads}$ ) were negative, indicating that these surfactants molecules have spontaneous tendencies to form micelles in solution at higher concentration and to get adsorb at the air/water interface at lower concentration. The TGA has indicated good thermally stability and activation energy for thermal decomposition was found in the range of 37.26–98.20 kJ/mol.

### GRAPHICAL ABSTRACT



### ARTICLE HISTORY

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Accepted 28 January 2024

### KEYWORDS

Surface tension; thermal decomposition; adsorption efficiency; micellization



# State-of-art review on smart perovskites materials: properties and applications

Priyanka Thakur<sup>1</sup> · Navdeep Sharma<sup>2</sup> · Dinesh Pathak<sup>3</sup> · Pankaj Sharma<sup>4</sup> · Kamal Kishore<sup>5</sup> · Shashi Dhar<sup>6</sup> · Madan Lal<sup>7</sup>

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## Abstract

Materials science has played a very crucial role in developing new technologies so far that could probably address the challenges of economic and ecological sustainability soon. In the field of advanced materials, perovskite oxides stand out to provide a clean environment, ensure enough clean energy, and sanitized water, and provide resources for industrial and growing populations. Perovskite oxides are green and eco-friendly smart materials whose properties might be significantly altered under controlled conditions. In this regard, lead-free perovskite ceramics and their composites such as  $\text{BaTiO}_3$ ,  $\text{K}_{0.5}\text{Na}_{0.5}\text{NbO}_3$ ,  $\text{Bi}_{0.5}\text{Na}_{0.5}\text{TiO}_3$ ,  $\text{LaMnO}_3$ ,  $\text{BaMnO}_3$ ,  $\text{LaFeO}_3$ ,  $\text{K}_{0.5}\text{Na}_{0.5}\text{NbO}_3\text{-BiFeO}_3$ ,  $\text{BaTiO}_3\text{-K}_{0.5}\text{Na}_{0.5}\text{NbO}_3$ ,  $\text{BaTiO}_3\text{-Bi}_{0.5}\text{Na}_{0.5}\text{TiO}_3$ , and many more are gaining attention due to their simple stoichiometry, cost-effectiveness, easy synthesis, eco-friendly behavior, and world-wide applications. In this review, a brief overview is given of the crystal structure and piezoelectric, ferroelectric, magnetic, and multiferroic properties of perovskite oxides. An attempt has been made to cover the progress of selective perovskite oxide and its composites. The recent advances of these perovskite oxides and applications in energy storage, energy scavenging applications via multi-layer ceramic capacitors, supercapacitors, solid-oxide fuel cells, piezoelectric actuators, transducers, sensors, and spintronics are also highlighted. Moreover, recent industrial developments based on these selective perovskite oxides are discussed as well. At the end of this review, future perspectives on current developments of perovskite oxides are also evaluated.

**Keywords** SDGs · Antiferromagnetic · Relaxor · Superexchange multiferroic · Supercapacitors

## 1 Introduction

In a world with energy crises, pollution, water contamination, and climate change, choosing an alternative has become essential for all living beings. Various natural and human conducts are responsible for accelerating these issues. However, for the betterment of the world, different initiatives have been taken so far. Laws enforced by governments and different social activities have successfully brought awareness among the people. These are the direct initiatives that highly impact the world population, aware and educate them about their participation in resolving these issues, and are responsible for choosing green alternatives for the environment and society [1]. Sustainable Development Goals (SDGs) are one of the direct initiatives which encapsulate almost all global issues from ending poverty to protecting the planet. The recognized 17 SDGs integrate that action in one area will affect outcomes in others, and the development will balance social, economic, and environmental

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Published online: 26 February 2024



Dissertations submission by PG Students:

**A Study on Hyperbolic Partial Differential Equations in Cancer Modelling**

THESIS

SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF

**MASTER OF SCIENCE**

IN

**MATHEMATICS**

By

**Neha Sharma**

Reg. No. : BS16MSMA001

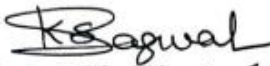



Dept. of Mathematics  
Akai College of Basic Science  
Eternal University  
Baru Sahib-173101, Sirmour (H.P.), India


July, 2018


CERTIFICATE - II

We, the undersigned, members of Research Degree Committee of Ms. **Neha Sharma**, Reg. No.: BS16MSMA001 a candidate for the degree of **Master of Science** with major mathematics agree that the thesis entitled "**A Study on Hyperbolic Partial Differential Equations in Cancer Modelling**" may be submitted in partial fulfillment of the requirements for the degree.


  
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(Prof. B.S. Sohal)  
Dean ACBS

  
(Dr. Dinesh Kumar)  
Dept. of Mathematics

  
(Prof. Sandipan Gupta)  
HOD of Mathematics

Approved

  
(Prof. B.S. Sohal)  
Dean PGS

Eternal University, Baru Sahib  
Dated: ..21 Sept, 18..

**SOLUTION OF FRACTIONAL DIFFERENTIAL EQUATIONS AND ITS  
APPLICATIONS**

**THESIS**

**SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF**

**MASTER OF SCIENCE  
IN  
MATHEMATICS  
BY**

**BHARTI THAKUR  
(BS17MSMA001)**



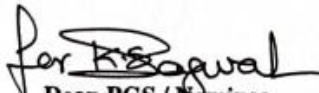
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**July 2019**

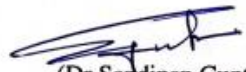



## CERTIFICATE – II

We, the undersigned, member of Research Degree Committee of Ms. **Bharti Thakur** Reg. No. (BS17MSMA001) a candidate for the degree of **Master of Science** with major **Mathematics** agree that the thesis entitled "**Solution of Fractional Differential Equations and its Applications**" may be submitted in partial fulfillment of the requirements for the degree.

  
Dean PGS / Nominee

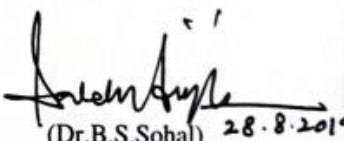
  
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(Akai College of Basic Sciences)

  
(Dr.Sandipan Gupta)  
Major Advisor

  
(Dr.Sandipan Gupta)  
Head  
(Department of Mathematics)

Eternal University, Baru Sahib  
Dated: 28.8.2019

Approved

  
(Dr.B.S.Sohal) 28.8.2019  
Dean PGS

**LEGENDRE WAVELET BASED NUMERICAL STUDY OF  
MOVING BOUNDARY PROBLEM OF HEAT MASS TRANSFER  
DURING IMMERSION FRYING**

**THESIS**

SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF

**MASTER OF SCIENCE**

**IN**

**MATHEMATICS**

**BY**

**HARPREET KAUR**

**(BS18MSMA001)**



AKAL COLLEGE OF BASIC SCIENCES  
ETERNAL UNIVERSITY  
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JULY 2020

## CERTIFICATE – II

We, the undersigned, member of Research Degree Committee of Ms. **Harpreet Kaur** Reg. No. (BS1SMSMA001) a candidate for the degree of **Master of Science** with major **Mathematics** agree that the thesis entitled “**Legendre wavelet Based numerical study of moving boundary problem of heat mass transfer during immersion frying**” may be submitted in partial fulfilment of the requirements for the degree.



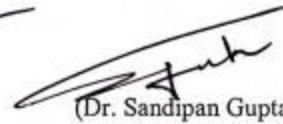
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Dr. S. Upadhyay  
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(Dr. Sandipan Gupta)  
Head  
(Department of Mathematics)

Approved



(Dr. B.S. Sohal)  
Dean PGS

Eternal University, Baru Sahib

Dated: 19/7/2020



**GENETIC DIVERSITY ASSESSMENT IN *Zanthoxylum armatum* DC  
AMONG DIFFERENT DISTRICTS OF HIMACHAL PRADESH**

**THESIS**

Submitted to the Eternal University, Baru Sahib in the Partial Fulfilment of the  
Requirements for the Degree of

**MASTER OF SCIENCE  
in  
BIOTECHNOLOGY**

by  
**RENUKA THAKUR  
(BS20MSBT001)**

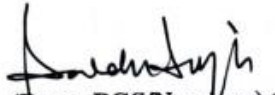


**DR. KHEM SINGH GILL AKAL COLLEGE OF AGRICULTURE,  
ETERNAL UNIVERSITY, BARU SAHIB,  
HIMACHAL PRADESH-173101**

**AUGUST, 2022**

## CERTIFICATE – II

We, the undersigned, members of Research Degree Committee of **Ms. Renuka Thakur (Reg. No. BS20MSBT001)** a candidate for the degree of **Master of Science** with major **Biotechnology** agree that the thesis entitled "**Genetic Diversity Assessment in *Zanthoxylum armatum* DC Among Different Districts of Himachal Pradesh**" may be submitted in partial fulfillment of the requirements for the degree.


  
(Dean, PGS/Nominee)

  
(Dr S. K. Sharma)

**Dean**  
**Dr Khem Singh Gill Akal**  
**College of Agriculture**

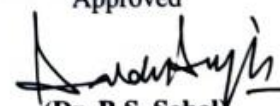
  
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**Head**  
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**Breeding and Biotechnology**

**Eternal University, Baru Sahib**  
**Date: 24.08.2022**

Approved  
  
(Dr. B.S. Sohal)  
**Dean PGS**

**EFFECT OF INTEGRATED NUTRIENT MANAGEMENT WITH  
MULCHING ON BLACKGRAM (*Vigna mungo L.*) IN MID HILL  
REGION OF HIMACHAL PRADESH**

**THESIS**

**SUBMITTED TO ETERNAL UNIVERSITY IN THE PARTIAL  
FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE  
DEGREE OF**

**MASTER OF SCIENCES**

**In  
AGRONOMY**

**By**

**GURJOT KAUR SANDHU  
(BS17MSAGN001)**



**Dr. KS GILL AKAL COLLEGE OF AGRICULTURE  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH-173101(INDIA)  
DECEMBER, 2020**





CONTENTS

**CERTIFICATE-II**

We, the undersigned, members of Research Degree Committee of Ms. Gurjot Kaur Sandhu Reg. No. (BS17MSAGN001) a candidate for the degree of Master of Science in Agronomy agree that this dissertation entitled “Effect of Integrated Nutrient Management with Mulching on Blackgram (*Vigna mungo L.*) in Mid Hill Region of Himachal Pradesh” may be submitted in partial fulfilment of the requirements for the degree.

Dean PGS / Nominee

(Dr. S.K. Sharma )

Dean/Nominee

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Baru Sahib

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HOD

Department Genetic  
Plant Breeding and  
Biotechnology

Dated: 14.01.2021

Approved

(Dr. B.S. Sohal)  
(Dean PGS)

**EFFECT OF INTEGRATED NUTRIENT MANAGEMENT AND  
SOWING DATES ON GROWTH AND YIELD OF TORIA (*Brassica  
compestris*) IN MID HILL REGION OF HIMACHAL PRADESH**

**THESIS**

SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB IN  
PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF

**MASTER OF SCIENCE  
IN  
AGRONOMY**

By


**BHANUPRIYA (BS18MSAGN001)**

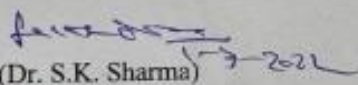


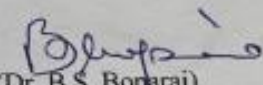
**DEPARTMENT OF AGRONOMY  
DR. KHEM SINGH GILL AKAL COLLEGE OF AGRICULTURE  
ETERNAL UNIVERSITY, BARU SAHIB,  
SIRMAUR HIMACHAL PRADESH-173101 (INDIA)**

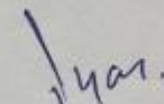
## CERTIFICATE- II

We, the undersigned, member of Research Degree Committee of **Ms. Bhanupriya** Registration No. **BS18MSAGN001** a candidate for the degree of Master of Science in Agronomy agrees that the thesis entitled **“Effect of integrated nutrient management and sowing dates on growth and yield of Toria (*Brassica campestris*) in Mid Hill Region of Himachal Pradesh”** may be submitted in partial fulfilment of the requirements for the degree.

  
Prof. B.S. Sohal  
Dean PGS/Nominee

  
(Dr. S.K. Sharma)  
Dean  
Dr. Khem Singh Gill Akal  
College of Agriculture,  
Eternal University, Baru  
Sahib

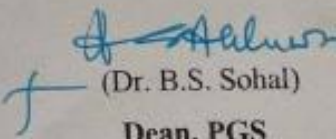
  
(Dr. B.S. Boparai)  
Major Advisor  
Dr. KS Gill Akal College of  
Agriculture, Eternal  
University, Baru Sahib

  
(Dr. Pritesh Vyas)  
Associate Professor  
Head  
Deptt. of Agriculture

Approved

Eternal University, Baru Sahib

Date: 1/3/22

  
(Dr. B.S. Sohal)  
Dean, PGS



ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਵਿਤਾ ਵਿਚ ਪੇਸ਼ ਸ੍ਰੀ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਦੇ ਬਿੰਬ ਦਾ ਵਿਚਾਰਧਾਰਾਈ  
ਅਧਿਐਨ

(ਚੋਣਵੇਂ ਕਵੀਆਂ ਦੀਆਂ ਕਵਿਤਾਵਾਂ ਦੇ ਪ੍ਰਸੰਗ ਵਿਚ)

**THESIS**

**SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS**

**FOR THE DEGREE OF**

**MASTER OF ARTS**

**IN PUNJABI**

**BY**

**Gurpreet Kaur**

**(BS19MAPBI001)**

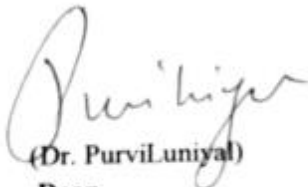


**AKAL COLLEGE OF ARTS & SOCIAL SCIENCES  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH- 173101, (INDIA)  
FEBRUARY, 2022**


**CERTIFICATE-II**

We, the undersigned, members of Research Degree Committee of Ms. Gurpreet Kaur, Reg. No. **BS19MAPBI001** a candidate for the degree of Master of Arts in Punjabi agree that the thesis entitled "ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਵਿਤਾ ਵਿਚ ਪੇਸ਼ ਸ੍ਰੀ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਦੇ ਬਿੰਬ ਦਾ ਵਿਚਾਰਧਾਰਾਈ ਅਧਿਐਨ (ਚੋਟਵੇਂ ਕਵੀਆਂ ਦੀਆਂ ਕਵਿਤਾਵਾਂ ਦੇ ਪ੍ਰਸੰਗ ਵਿਚ)" may be submitted in partial fulfillment of the requirements for the degree.

  
Dean PGS/Nominee

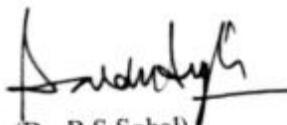
  
(Dr. Purvi Luniyal)  
Dean  
Akal College of Arts  
and Social Sciences

  
(Dr. Simranjit Singh)  
Major Advisor

  
(Dr. Simranjit Singh)  
Assistant Professor  
And HoD  
Department of Punjabi

Approved

Eternal University  
Date : 10-08-2022

  
(Dr. B.S. Sohal)  
Dean Post Graduate Studies

ਨਾਰੀ ਸੰਵੇਦਨਾ ਦੇ ਪੱਖ ਤੋਂ ਸਰਬਜੀਤ ਕੌਰ ਜੱਸ ਦੀ ਪੁਸਤਕ 'ਤਾਮ' ਦਾ ਵਿਸ਼ਾਗਤ ਅਧਿਐਨ  
(ਚੋਣਵੀਆਂ ਕਵਿਤਾਵਾਂ ਦੇ ਸੰਦਰਭ ਵਿਚ)

**THESIS**

**Submitted to the Eternal University, Baru Sahib  
in Partial Fulfillment of Requirements  
for the Degree of**

**MASTER OF ARTS**

**in**

**PUNJABI**

**by**

**GURPREET KAUR**

**(BS20MAPBI001)**



**Department of Punjabi**

**Akal College of Arts and Social Sciences**

**ETERNAL UNIVERSITY**

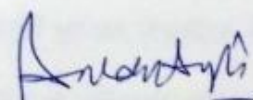
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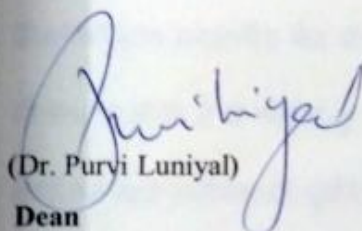
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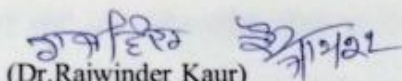
**CERTIFICATE-II**

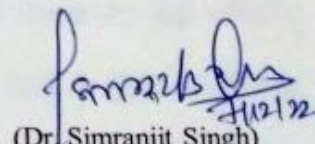
We, the undersigned, members of Research Degree Committee of **Ms. Gurpreet Kaur**, Reg. No. **BS20MAPBI001** a candidate for the degree of Master of Arts in Punjabi agree that the thesis entitled "ਨਾਰੀ ਸੰਵੇਦਨਾ ਦੇ ਪੱਖ ਤੋਂ ਸਰਬਜੀਤ ਕੌਰ ਜੱਸ ਦੀ ਕਾਵਿ ਪੁਸਤਕ "ਤਾਮ" ਦਾ ਵਿਸ਼ਾਗਤ ਅਧਿਐਨ (ਚੋਣਵੀਆਂ ਕਵਿਤਾਵਾਂ ਦੇ ਪ੍ਰਸੰਗ ਵਿਚ)" may be submitted in partial fulfillment of the requirements for the degree.

  
**Dean PGS/Nominee**

  
**(Dr. Purvi Luniyal)**  
**Dean**

**Akal College of Arts  
and Social Sciences**

  
**(Dr. Rajwinder Kaur)**  
**Major Advisor**

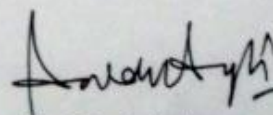
  
**(Dr. Simranjit Singh)**  
**Head**

**Department of Punjabi**

**Approved**

**Eternal University**

**Date : 7/12/22**

  
**(Dr. B.S. Sohal)**

**Dean Post Graduate Studies**

**EFFECTS OF DEPRESSION ON ACADEMIC PERFORMANCE AND  
PSYCHOLOGICAL WELLBEING AMONG COLLEGE STUDENTS**

**THESIS**

SUBMITTED TO ETERNAL UNIVERSITY, BARU SAHIB

IN PARTIAL FULFILLMENT OF THE REQUIREMENT

FOR THE DEGREE OF

MASTER OF SCIENCE

IN

PSYCHOLOGY

BY

KOMAL RANI

(BS19MSPSY002)



**AKAL COLLEGE OF ARTS AND SOCIAL SCIENCES**

**ETERNAL UNIVERSITY**

**BARU SAHIB, HIMACHAL PRADESH- 173101 (INDIA)**

**SEPTEMBER, 2021**

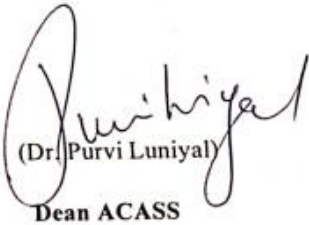
## CERTIFICATE – II

We the undersigned, member of the Research Degree Committee of Ms. **Komal Rani** Reg. No. (BS19MSPSY002) a candidate for the degree of **Master of Science** with major Psychology agree that the thesis entitled “**EFFECTS OF DEPRESSION ON ACADEMIC PERFORMANCE AND PSYCHOLOGICAL WELLBEING AMONG COLLEGE STUDENTS**” may be submitted in partial fulfilment of the requirements for the degree.

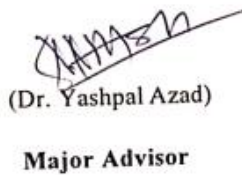


Signature

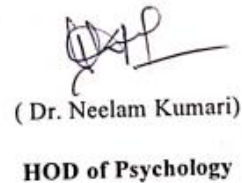
Dean PGS/Nominee



(Dr. Purvi Luniyal)  
Dean ACASS



(Dr. Yashpal Azad)  
Major Advisor

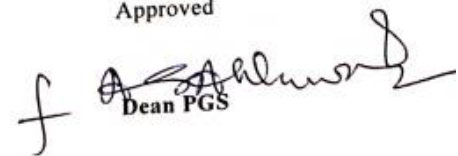


(Dr. Neelam Kumari)  
HOD of Psychology

Eternal University, Baru Sahib

Date: 20/12/21

Approved



Dean PGS



**IMPACT OF ONLINE EDUCATION ON THE PSYCHOLOGICAL WELL-  
BEING AND ACADEMIC PERFORMANCE OF STUDENTS DURING  
COVID-19 PANDEMIC**

**THESIS**

**Submitted to the Eternal University, Baru Sahib in the Partial Fulfilment of the  
Requirements for the Degree of**

**MASTER OF SCIENCE**

**in  
PSYCHOLOGY**

**BY**

**NIRMALJEET KAUR  
(BS20MSPSY003)**



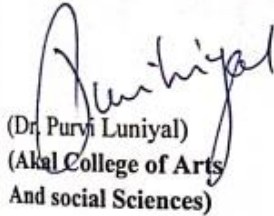
**DEPARTMENT OF PSYCHOLOGY  
AKAL COLLEGE OF ARTS AND SOCIAL SCIENCES  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH- 173101 (INDIA)**

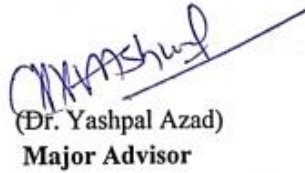
**JULY 2022**

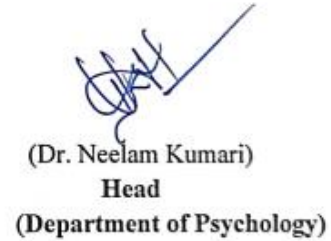
## CERTIFICATE – II

We the undersigned, member of the Research Degree Committee of Ms. Nirmaljeet Kaur Reg. No. (BS20MSPSY003) a candidate for the degree of **Master of Science** with major Psychology agree that the thesis entitled **“IMPACT OF ONLINE EDUCATION ON THE PSYCHOLOGICAL WELL-BEING AND ACADEMIC PERFORMANCE OF STUDENTS DURING COVID-19 PANDEMIC”** may be submitted in partial fulfilment of the requirements for the degree.

  
Dean PGS/Nominee

  
(Dr. Purvi Luniyal)  
(Akal College of Arts  
And social Sciences)

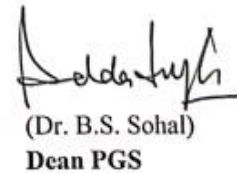
  
(Dr. Yashpal Azad)  
Major Advisor

  
(Dr. Neelam Kumari)  
Head  
(Department of Psychology)

Approved

Eternal University, Baru Sahib

Dated: 05.11.2022

  
(Dr. B.S. Sohal)  
Dean PGS

**THE INFLUENCE OF STRONTIUM SUBSTITUTION ON NICKEL SITE  
IN NANOSTRUCTURED NICKEL FERRITE**

**THESIS**

SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF

**MASTER OF SCIENCE**

**IN**

**PHYSICS**

**BY**

**CHIRAG**

**(BS16MSPHY001)**



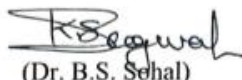
**AKAL COLLEGE OF BASIC SCIENCES  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH-173101(INDIA)**

**July, 2018**



CERTIFICATE – II

We, the undersigned, members of Research Degree Committee of Chirag Reg. No. (BS16MSPHY001) a candidate for the degree of **Master of Science** with major **Physics** agree that the thesis entitled "**THE INFLUENCE OF STRONTIUM SUBSTITUTION ON NICKEL SITE IN NANOSTRUCTURED NICKEL FERRITE.**" may be submitted in partial fulfillment of the requirements for the degree.



(Dr. B.S. Sohal)

**Dean PGS / Nominee**



(Dr. B.S. Sohal)


**Dean/Nominee**

**(Akal College of Basic Sciences)**



(Dr. Puneet Negi)

Assistant Professor  
Department of Physics  
**Major Advisor**



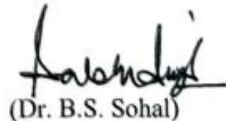
(Dr. Radheshyam Rai)

**(Head of Department, Physics)**

Approved

**Eternal University, Baru Sahib**

Dated: 28.09.2018



(Dr. B.S. Sohal)

**Dean PGS**

**STUDY THE CHARGE TRANSPORT AND FABRICATION OF  
INTERLAYER IN ORGANIC-HYBRID SOLAR CELL**

**THESIS**

SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF

**MASTER OF SCIENCE**

**IN**

**PHYSICS**

**BY**

**SIMRAN KUMARI**

**(BS17MSPHY002)**



**AKAL COLLEGE OF BASIC SCIENCES**

**ETERNAL UNIVERSITY**

**BARU SAHIB, HIMACHAL PARDESH-173101(INDIA)**

**JULY 2019**

## CERTIFICATE – II

We, the undersigned, members of Research Degree Committee of Ms. Simran Kumari Reg. No. (BS17MSPHY002) a candidate for the degree of **Master of Science** with major **Physics** agree that the thesis entitled “**STUDY OF CHARGE TRANSPORT AND FABRICATION OF INTERLAYER IN ORGANIC-HYBRID SOLAR CELL.**” may be submitted in partial fulfillment of the requirements for the degree.



Signature  
(Dr. B.S. Sohal)  
**Dean PGS / Nominee**



Signature  
(Dr. B.S. Sohal)  
**Dean**  
(Akal College of Basic Sciences)



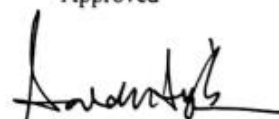
Signature  
(Dr. Radheyshyam Rai)  
Associate Professor  
**Major Advisor**



Signature  
(Dr. Radheyshyam Rai)  
**(Head of Department, Physics)**

Eternal University, Baru Sahib  
Dated: 23.09.2019

Approved



(Dr. B.S. Sohal)  
**Dean PGS**



**SYNTHESIS AND CHARACTERIZATION OF CO-DOPED ZINC OXIDE  
NANOPARTICLES FOR DYE SENSITIZED SOLAR CELL  
APPLICATION**

**THESIS**

SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF

**DOCTOR OF PHILOSOPHY**

**IN**

**PHYSICS**

**BY**

**MANPREET KAUR  
(BS16PSPHY002)**




**AKAL COLLEGE OF BASIC SCIENCES  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH-173101(INDIA)**

**MAY 2019**

## CERTIFICATE - II

We, the undersigned, members of Research Degree Committee of **Ms. Manpreet Kaur** Reg. No. (BS16PSPHY002) a candidate for the degree of **Doctor of Philosophy in Physics** agree that the thesis entitled "**Synthesis and Characterization of Co-doped Zinc Oxide Nanoparticles for Dye Sensitized Solar Cell Application**" may be submitted in partial fulfillment of the requirements for the degree.



(Dr. B.S. Sohal)

**Dean PGS / Nominee**



(Dr. B.S. Sohal)

**Dean / Nominee**

**(Akal College of Basic Sciences)**



(Dr. Rakesh Sharma)

**Assistant Professor**

**Major Advisor**




(Dr. Radheshyam Rai)

**(Head)**

**(Department of Physics)**

Approved



(Dr. B.S. Sohal)

**Dean PGS**

**Eternal University, Baru Sahib**

Date: 09.05.2019

**SYNTHESIS AND CHARACTERIZATION OF TRI-DOPED TITANIUM  
DIOXIDE NANOSTRUCTURES FOR DYE SENSITIZED SOLAR CELL  
APPLICATION**

**THESIS**

SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF

**DOCTOR OF PHILOSOPHY  
IN  
PHYSICS  
BY**

**GURSIMRAN KAUR  
(BS15PSP001)**



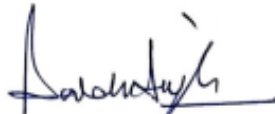
**AKAL COLLEGE OF BASIC SCIENCES  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH-173101 (INDIA)**

**SEPTEMBER, 2019**



## CERTIFICATE - II

We, the undersigned, members of Research Degree Committee of **Mrs. Gursimran Kaur** Reg. No. (BS15PSP001) a candidate for the degree of **Doctor of Philosophy in Physics** agree that the thesis entitled "**Synthesis and Characterization of Tri-doped Titanium Dioxide Nanostructures for Dye Sensitized Solar Cell Application**" may be submitted in partial fulfillment of the requirements for the degree.



(Prof. B.S. Sohal)

**Dean PGS / Nominee**



(Prof. Sandipan Gupta)

**Dean/ Nominee**

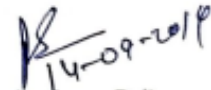
**Akal College of Basic Sciences**



(Dr. Puneet Negi)

**Assistant Professor**

**Major Advisor**



(Dr. Radheshyam Rai)

**Head**

**Department of Physics**

Approved



(Prof. B.S. Sohal)

**Dean PGS**

**Eternal University, Baru Sahib**

Date: 14.09.2019

**EFFECT OF MULCHES AND FERTIGATION LEVELS ON GROWTH,  
YIELD AND QUALITY OF TOMATO (*Solanum lycopersicum* L.)  
CULTIVAR HEEM SOHNA UNDER PROTECTED CONDITIONS**

**THESIS**

SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB IN PARTIAL  
FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

**MASTER OF SCIENCE**

**In**

**Ag. HORTICULTURE (VEGETABLE SCIENCE)**

**By**

**DIVYAKSHI  
(BS19MSHC002)**



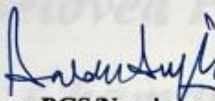
DEPARTMENT OF HORTICULTURE  
Dr. KHEM SINGH GILL AKAL COLLEGE OF AGRICULTURE  
ETERNAL UNIVERSITY, BARU SAHIB,  
SIRMAUR HIMACHAL PRADESH-173101 (INDIA)  
AUGUST, 2021




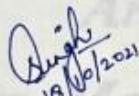
**ETERNAL UNIVERSITY, BARU SAHIB**

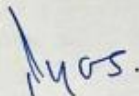
**CERTIFICATE- II**

We, the undersigned, member of Research Degree Committee of **Ms. Divyakshi** Registration No. **BS19MSHC002** a candidate for the degree of Master of Science in Ag. Horticulture (Vegetable Science) agrees that the thesis entitled **“Effect of mulches and fertigation levels on growth, yield and quality of tomato (*Solanum lycopersicum* L.) cultivar Heem Sohna under protected conditions”** may be submitted in partial fulfilment of the requirements for the degree.

  
**Dean PGS/Nominee**

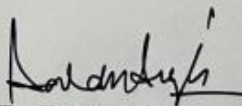
  
(Dr. S.K. Sharma)  
**Dean**  
**Dr. Khem Singh Gill Akal**  
**College of Agriculture**

  
(Dr. Shalini Singh)  
**Assistant Professor**  
**Major Advisor**  
**Dept. of Horticulture**

  
(Dr. Pritesh Vyas)  
**Associate Professor**  
**Head**  
**Agriculture**

Approved

**Eternal University, Baru Sahib**  
Date: 18/10/2021

  
(Dr. B.S. Sohal)  
**Dean, PGS**



**CHARACTERIZATION OF BEETROOT POMACE ENRICHED MUFFINS**

**THESIS**

**SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF**

**MASTER OF SCIENCE  
IN  
FOOD TECHNOLOGY  
BY**

**MANPREET KAUR  
(BS20MSFT001)**



**DR. KHEM SINGH GILL AKAL COLLEGE OF AGRICULTURE  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH-173101 (INDIA)**

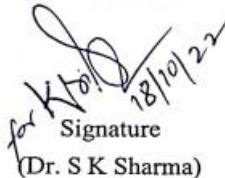
**AUGUST 2022**

## CERTIFICATE – II

We, the undersigned, members of Research Degree Committee of **Ms. Manpreet Kaur** Reg. No. BS20MSFT001 a candidate for the degree of Master of Science in Food Technology agree that the thesis entitled “**Characterization of Beetroot Pomace enriched muffins**” may be submitted in partial fulfillment of the requirements for the degree.



Signature  
(Dr. B.S. Sohal)  
**Dean PGS/Nominee**



Signature  
(Dr. S K Sharma)  
**Dean**  
**(Dr. KSG Akal College**  
**of Agriculture)**



Signature  
(Dr. Tajendra Pal Singh )  
**Major Advisor**  
**(Department of Food**  
**Technology)**



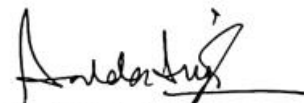
Signature  
(Dr. Krishan Kumar)  
**HoD**  
**(Department of Food**  
**Technology)**

**Approved**



Eternal University Baru Sahib

Dated: 18/10/22



(Dr. B.S. Sohal)  
**Dean PGS**

**EFFECT OF HYDROPHOBIC CHAIN LENGTH ON INTERFACIAL  
PROPERTIES AND THERMODYNAMIC ASPECTS FOR SELF  
ASSEMBLY OF METHYL-IMIDAZOLIUM MONOMERIC  
SURFACTANTS**

**THESIS**

Submitted to the Eternal University, Baru Sahib in the Partial Fulfilment of the  
Requirements for the Degree of

**MASTER OF SCIENCE  
in  
CHEMISTRY**

by

**SWINKY PATHANIYA  
(BS20MSCH001)**



**Department of Chemistry and Biochemistry  
Akal College Basic Sciences  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH-173101(INDIA)**

**AUGUST 2022**



## CERTIFICATE-II

We, the undersigned, members of Research Degree Committee of Swinky Pathaniya (Reg. No.BS20MSCH001) a candidate for the degree of **Master of Science** with major Organic Chemistry agree that the thesis entitled "**Effect of hydrophobic chain length on interfacial properties and thermodynamic aspects for self assembly of methyl-imidazolium monomeric surfactants**" may be submitted in partial fulfillment of the requirements for the degree.



(Nominee)

**Dean PGS/Nominee**



(Prof. Sandipan Gupta)

**Dean  
Akal College of Basic  
Science**



(Dr. Kamal Kishore)


**Major Advisor  
Department of Chemistry  
and Biochemistry**



(Prof. B.S. Sohal)

**Head  
Department of Chemistry  
and Biochemistry**

Approved



(Prof. B.S. Sohal)

**Dean PGS**

**Eternal University, Baru sahib**

Dated: 12/09/22

**SYNTHESIS AND SPECTRAL STUDIES OF 4-FUNCTIONAL  
PYRAZOLYLTHIAZOLES AND THEIR BIOLOGICAL  
INVESTIGATION**

**THESIS**

Submitted to Eternal University, Baru Sahib, District Sirmaur,  
Himachal Pradesh

For the degree of  
**DOCTOR OF PHILOSOPHY**  
IN  
**CHEMISTRY**

By

**Poonam Kumari**  
**(BS14PSCH001)**



**Department of Chemistry**  
**Akal College of Basic Sciences**  
**Eternal University, Baru Sahib**  
**Himachal Pradesh-173101 (INDIA)**  
**Feb. 2020**

## CERTIFICATE – II

We, the undersigned, members of Research Degree Committee of Ms. **Poonam Kumari** (Reg. No. BS14PSCH001) a candidate for the degree of **Doctor of Philosophy in Chemistry**, agree that the thesis entitled “**Synthesis and spectral studies of 4-functional pyrazolythiazoles and their biological investigation**” may be submitted in partial fulfillment of the requirements for the degree.

  
Dean, PGS

  
(Prof. Karan Singh)

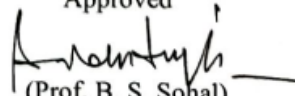
**Major Advisor/Head**  
**Department of Chemistry**

  
(Prof. Sandipan Gupta)

**Dean**  
**(Akal college of Basic Sciences)**  
Eternal University, Baru Sahib  
Sirmaur, Himachal Pradesh

**Eternal University, Baru Sahib**

Dated: 11-Aug-2021


Approved  
  
(Prof. B. S. Sohal)


**Dean PGS**

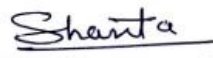



**CERTIFICATE- II**

We, the undersigned members of Research Degree Committee of Ms. **Kajal Choudhary** (BS19MSEC002), a candidate for the degree of **Master of Science** with major Economics, agree that the thesis entitled "**Impact of climate change on agriculture : A study of Sirmour district in Himachal pradesh** " may be submitted in partial fulfillment of the requirements for the degree.

  
(Dr. Baldev Singh Sohal)  
**Dean PGS/ Nominee**

  
24/12/2021  
(Dr. S. K. Chauhan)  
**Dean**  
(Akal College of Economics,  
Commerce and Management)

  
(Dr. Shanta Kumari)  
**Major Advisor**  
(Department of Economics)

  
24/12/2021  
(Dr. S. K. Chauhan)  
**Head**  
(Department of Economics)

Approved

Eternal University, Baru Sahib  
Dated: 24/12/2021

  
(Dr. Baldev Singh Sohal)  
**Dean PGS**

## CERTIFICATE- II

We, the undersigned, members of Research Degree Committee of Ms. Anita Pandwar Reg. No. BS19MSECO01, a candidate for the degree of Master of Science with major Economics, agree that the thesis entitled **“Role of Women in Dairy Farming in Nahani Block of District Sirmour, Himachal Pradesh”** may be submitted in partial fulfilment of the requirements for the degree.



Signature

(Dr. B.S. Sohal)

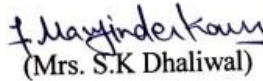
Dean PGS/Nominee



(Dr. S.K. Chauhan)

Dean

(Akal College of Economics,  
Commerce and Management)



(Mrs. S.K. Dhaliwal)

Major Advisor

(Department of Economics)



(Dr. S.K. Chauhan)

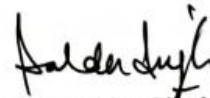
Head

(Department of  
Economics)

Approved

Eternal University, Baru Sahib

Dated: 13-10-2021



(Dr. Baldev Singh Sohal)

Dean PGS

## CERTIFICATE – II

We, the undersigned, members of Research Degree Committee of **Ms. Manvinder Kaur**, Reg. No. BS19MSEC003, a candidate for the degree of Master of Science with major Economics, agree that the thesis entitled **“ROLE OF PANCHAYATI RAJ INSTITUTIONS IN RURAL DEVELOPMENT OF DISTRICT SIRMOUR, HIMACHAL PRADESH”** may be submitted in partial fulfilment of the requirements for the degree.



Signature

(Dr. B.S. Sohal)

Dean PGS/Nominee



(Dr. S.K. Chauhan)

Dean/ Nominee

(Akal College of Economics,  
Commerce and Management)



(Dr. S.K. Chauhan)

Major Advisor



(Dr. S.K. Chauhan)

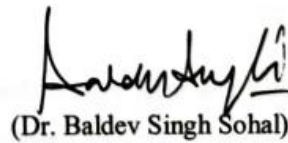
Head

(Department of Economics)

Approved

Eternal University, Baru Sahib

Dated: 22.11.2021



(Dr. Baldev Singh Sohal)

Dean PGS



**A STUDY ON THE EFFECT OF CORPORATE SOCIAL  
RESPONSIBILITY ON CONSUMER BUYING BEHAVIOUR IN CASE  
OF FAST MOVING CONSUMER GOODS**

**THESIS**

**SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB IN THE PARTIAL  
FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF**

**MASTER OF BUSINESS ADMINISTRATION  
IN  
FINANCE**

**BY**

**SIMRANJIT KAUR  
(BS21MBM001)**




**Department of Management  
Akal College of Economics, Commerce and Management  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH- 173101 (INDIA)**

**SEPTEMBER, 2023**

## CERTIFICATE-II

We, the undersigned, members of the Research Degree Committee of **Simranjit Kaur**, Reg. No. (BS21MBM001), a candidate for the degree of **Master of Business Administration** with major in **Finance** agrees that the thesis entitled "**A Study on the Effect of Corporate Social Responsibility on Consumer Buying Behaviour in Case of Fast Moving Consumer Goods**" may be submitted in partial fulfilment of the requirements for the degree.

  
Dean PGS/Nominee

  
(Dr. S.K. Chauhan)


**Dean**

**Akal College of Economics,  
Commerce and Management**

  
(Mr. Amit Kumar)

**Major Advisor**

**Assistant Professor  
Department of Management**

  
(Dr. S.K. Chauhan)

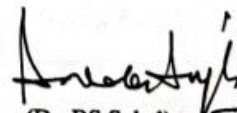
**Head**

**Akal College of Economics,  
Commerce and Management**

Approved

**Eternal University, Baru Sahib**

Dated: 08-09-2023

  
(Dr. BS Sohal)

**Dean Post Graduate Studies**

**A STUDY ON INVESTMENT PATTERN AND CUSTOMERS PERCEPTION  
TOWARDS MUTUAL FUNDS IN DELHI**

**THESIS**

**Submitted to Eternal University, Baru Sahib in the Partial Fulfillment of the  
Requirements for the Degree of**

**MASTER OF BUSINESS ADMINISTRATION**

**in**

**FINANCE**

**by**

**SHUBHI AGGARWAL**

**(BS20MBA004)**



**Department of Management**

**Akal College of Economics Commerce and Management**

**ETERNAL UNIVERSITY, BARU SAHIB, SIRMOUR, (HP)**


**APRIL 2023**



## CERTIFICATE II

We, the undersigned, members of the Research Degree Committee of Ms. **Shubhi Aggarwal** Reg. No. (BS20MBA004) a candidate for the Master of Business Administration degree with a major in Finance agrees that the thesis entitled "**A Study on Investment Pattern and Customers Perception Towards Mutual Funds in Delhi**" may be submitted in partial fulfillment of the requirements for the degree.

  
**Dean Post Graduate Studies/Nominee**

  
4/04/2023  
**Dr. S.K. Chauhan**

**Dean**

Akal College of Economics,  
Commerce and Management

  
4/04/2023  
**Dr. Jai Kumar Sharma**

**Major Advisor**


  
04/04/2023  
**Dr. S.K. Chauhan**

**H.O.D Commerce**

Approved

**Eternal University, Baru Sahib**

Dated: 4.04.2023

  
**Dr. Baldev Singh Sohal**

**Dean Post Graduate Studies**

**POWER POLITICS, QUEST FOR IDENTITY AND ASSIMILATION: A  
STUDY OF PETER CAREY'S *JACK MAGGS***

**THESIS**

**SUBMITTED TO THE ETERNAL UNIVERSITY, BARU SAHIB  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF**

**MASTER OF ARTS  
IN  
ENGLISH**

**BY**

**NAVDEEP KAUR  
(BS17MAEN001)**



**DEPARTMENT OF ENGLISH AND COMMUNICATION STUDIES  
AKAL COLLEGE OF ARTS AND SOCIAL SCIENCES  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH-173101 (INDIA)  
NOVEMBER-2019**



## CERTIFICATE

We, the undersigned number of Research Degree Committee of Ms Navdeep Kaur Reg. No. (BS17MAEN001) a candidate for the degree of M.A. (English) agree that the thesis entitled **“Power Politics, Quest for Identity and Assimilation: A Study of Peter Carey’s Jack Maggs”** may be submitted in partial fulfillment of the requirements for the degree.

Dr B.S. Sohal  
Dean PGS / Nominee

Dr Purvi Luniyal  
Dean / Nominee

Dr Nisha Thakur  
Major Advisor

Dr Kulbhushan Kumar  
Head  
(Department of English and  
Communication studies)

Approved

Eternal University, Baru Sahib

Dated: 09.11.2019

Dr B.S. Sohal  
Dean PGS

**EXPLORATION OF BENEFICIAL ENDOPHYTIC MICROBES  
ASSOCIATED WITH MEDICINAL PLANTS GROWING  
AROUND BARU SAHIB**

**THESIS**

**SUBMITTED TO ETERNAL UNIVERSITY, BARU SAHIB  
IN THE PARTIAL FULFILLMENT OF REQUIREMENTS FOR THE DEGREE OF**

**MASTER OF SCIENCE**

**In**

**Microbiology**

**By**

**Babita Sharma (BS21MMB001)**




**Department of Microbiology  
Akal College of Basic Sciences  
Eternal University, Baru Sahib, Sirmour, (HP)  
Himachal Pradesh-173101**

**August, 2023**

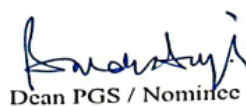


## CERTIFICATE-II

We, the undersigned members of Research Degree Committee of **Ms. Babita Sharma** Reg. No. (BS21MMB001) a candidate for the degree of Master of Science in Microbiology agree that the thesis entitled "**Exploration of beneficial endophytic microbes associated with medicinal plants growing around Baru Sahib**" may be submitted in partial fulfillment of the requirements for the degree.



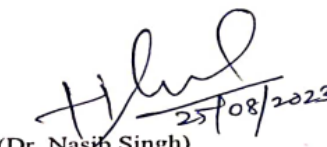
(Dr. Sandipan Gupta)  
**Dean**  
Akal College of Basic Sciences



Dean PGS / Nominice



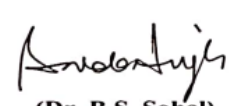
(Dr. Divjot Kour)  
**Major Advisor**  
Assistant Professor  
Department of Microbiology



(Dr. Nasib Singh)  
**Head**  
Associate Professor  
Department of Microbiology

Approved

Eternal University, Baru Sahib  
Date: 25 08 2023



(Dr. B.S. Sohal)  
Dean PGS

**ANTIMICROBIAL SUSCEPTIBILITY PROFILE AND PREVALENCE  
OF EXTENDED SPECTRUM  $\beta$ -LACTAMASE PRODUCING  
GRAM-NEGATIVE BACTERIA IN WASTEWATERS**

**THESIS**

Submitted to the Eternal University, Baru Sahib in the Partial Fulfilment of the  
Requirements for the Degree of

MASTER OF SCIENCE  
in  
**MICROBIOLOGY**

by

**ACHHADA UJALKAUR AVATSINGH**  
**(BS20MSMB001)**

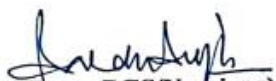


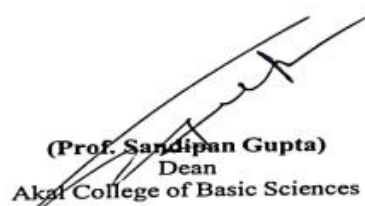
**DEPARTMENT OF MICROBIOLOGY  
AKAL COLLEGE OF BASIC SCIENCES  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH-173101 (INDIA)**


**AUGUST, 2022**

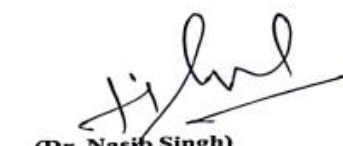
## CERTIFICATE-II

We, the undersigned, members of the Research Degree Committee of Ms. Achhada Ujalkaur Avatsingh (Reg. No. BS20MSMB001), a candidate for the degree of Master of Science with major Microbiology agree that the thesis entitled "Antimicrobial Susceptibility Profile and Prevalence of Extended Spectrum  $\beta$ -Lactamase Producing Gram-negative Bacteria in Wastewaters" may be submitted in partial fulfillment of the requirements for the degree.

  
(Dean, PGS/Nominee)

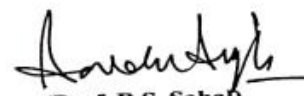
  
(Prof. Sandipan Gupta)  
Dean  
Akai College of Basic Sciences

  
(Dr. Nasib Singh)  
Major Advisor  
Dept. of Microbiology

  
(Dr. Nasib Singh)  
HOD  
Dept. of Microbiology

Approved

Eternal University, Baru Sahib  
Dated: 24-09-2022

  
(Prof. B.S. Sohal)  
Dean PGS

**INTESTINAL NEMATODES AND PROTOZOAN PARASITES  
OF DOMESTICATED HERBIVOROUS ANIMALS OF  
SIRMAUR, HIMACHAL PRADESH**

**DISSERTATION**

SUBMITTED TO ETERNAL UNIVERSITY IN PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF

**MASTER OF SCIENCE  
IN  
ZOOLOGY**

**BY  
ANUJA SHARMA  
(Regn. No. BS17MSZ001)**



**DEPARTMENT OF ZOOLOGY  
AKAL COLLEGE OF BASIC SCIENCES  
ETERNAL UNIVERSITY, BARU SAHIB, SIRMAUR (H.P.)**

**AUGUST, 2019**





## CERTIFICATE – II

We, the undersigned, member of Research Degree Committee of **Ms. Anuja Sharma** (Regn. No. BS17MSZ001), a candidate for the degree of Master of Science with major **Zoology** agree that this dissertation entitled “**Intestinal nematodes and protozoan parasites of domesticated herbivorous animals of Sirmaur, Himachal Pradesh**” may be submitted in partial fulfillment of the requirements for the degree.

**Prof. B. S. Sohal**

**(Dean PGS/ Nominee)**

**Prof. Sandipan Gupta**  
**Dean**

**(Akal College of Basic Sciences)**

**Dr. Nasib Singh**  
**(Major Advisor)**

**Dr. Neelam Thakur**  
**Head**  
**(Dept. of Zoology)**

**Eternal University, Baru Sahib**

**Dated: 05.11.2019**

**Approved**

**Prof. B. S. Sohal**

**(Dean PGS)**

**STUDIES ON SPECIES DIVERSITY OF MOTH FAUNA (INSECTA:  
LEPIDOPTERA) OF BARU SAHIB AND ADJOINING AREAS OF  
DISTRICT SIRMOUR, HIMACHAL PRADESH**

**THESIS**

**Submitted to the Eternal University, Baru Sahib in the Partial Fulfilment of the  
Requirements for the Degree of**

**MASTER OF SCIENCE  
in  
ZOOLOGY**

**by**

**JYOTIKA THAKUR  
(BS21MZY001)**



**Department of Zoology  
Akal College of Basic Sciences  
ETERNAL UNIVERSITY  
BARU SAHIB, HIMACHAL PRADESH-173101**

**AUGUST, 2023**


## CERTIFICATE-II

We the undersigned, member of Research Degree Committee of Ms. **Jyotika Thakur** (Reg No. BS21MZY001) a candidate for the degree of **Master of Science** with major **Zoology** agree that the thesis "**Studies on Species Diversity of Moth Fauna (Insecta: Lepidoptera) of Baru Sahib and Adjoining areas of District Sirmour, Himachal Pradesh**" may be submitted in partial fulfillment of the requirements for the degree.

  
Dean PGS / Nominee

  
(Dr. Sandipan Gupta)  
Dean Akal College  
of Basic Sciences

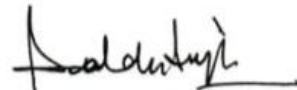
  
(Dr. Gagan Preet Kour Bali)  
Assistant Professor Major Advisor  
Department of Zoology

  
(Dr. Neelam Thakur)  
Assistant Professor Head  
Department of Zoology

Approved

Eternal University, Baru Sahib

Dated: 08/11/2023

  
(Dr. B. S. Sohal)

Dean Post Graduate Studies

**Internship Completion by the Students:**





## INTERNSHIP COMPLETION CERTIFICATE

THIS IS TO CERTIFY THAT

**Ms PAVIT KAUR**

Student of eternal university, Baru Sahib (HP) has completed her online project report on 'Review of literature of Social Determinants of Maternal Morbidity and Maternal Mortality in India'

from

Nirabhra Sustainable Development Foundation from 15<sup>th</sup> May to 15<sup>th</sup> July 2021



Dr Rajnish Gourh  
Director

Nirabhra Sustainable Development Foundation

## INTERNSHIP COMPLETION CERTIFICATE

THIS IS TO CERTIFY THAT

**Ms RAJNI**

Student of eternal university, Baru Sahib (HP) has completed her online project report on 'Situational analysis of child malnutrition in india: analysis the evidence from NFHS-5'

from

Nirabhra Sustainable Development Foundation from 15<sup>th</sup> May to 15<sup>th</sup> July 2021



Dr Rajnish Gourh  
Director

Nirabhra Sustainable Development Foundation