

**Annual Report: 2019-20**  
**Aryabhata center for Nanoscience and Nanotechnology**  
**Aryabhata Knowledge University, Patna**  
**Reported by-**

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**Academic(i/c)/ Head/ Prof. Incharge-Establishment** (from 1<sup>st</sup> April 2014)

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**Scientific activities citation**-[www.drrakeshsingh.com](http://www.drrakeshsingh.com)

**Google scholar profile**- <https://scholar.google.com/citations?user=gOZNJ-oAAAAJ&hl=en>

**Research gate profile**- [https://www.researchgate.net/profile/Rakesh\\_Singh44](https://www.researchgate.net/profile/Rakesh_Singh44)

Chancellor Awardee of Best Young Teacher with contributions modern field of Nanoscience

## Annual Report: 2019-20;

### Activity category-I

#### Curricular Aspects and Teaching- Learning and Evaluation, Organized as Coordinator

The courses taught at Aryabhata Center for Nano science & Nano technology are credit based where we emphasize on research project. For overall growth, we focus on learning through beyond Class room activities and university syllabus have been made such that students face the emerging challenges in our society. Students are given heavy dose of motivation, training, interaction with academicians and continuous learning. Academic Programmes are organized so that they developed critical attitude for sustained development. **In this context about 20 curricular related activities organized in this academic session.** The brief details of activities are discussed below.

#### 1.1. National Science day- 28 Feb 2020



Students of Nanoscience center of AKU, working under the supervision of Dr. Rakesh Kr Singh, receiving 1<sup>st</sup> prize at Rajbhawan Patna in a state level programme "Innovations and Entrepreneurship in Science Education and Research."

## Curricular Aspects and Teaching- Learning and Evaluation

The focal theme of National Science day-2020 was ' Innovation and Entrepreneurship'. In this occasion, a programme was organized at Rajbhawan Patna by Munger university. All the University of Bihar including IIT, NIT, BIT and +2 schools students participated. Faculty member and students of Nanoscience center participated at Rajbhawan Patna. State level research presentation was organized. Hon'ble His excellency Governor of Bihar also visited the research activities of nanoscience center, presented in the form of poster, which was supervised by Dr. Rakesh Kr Singh, Head-Academic. The research activities were presented are (1) Nanosilica production from rice husk and their applications by Md. Muzzammil Siddiqui., Rahul Kr Raman, Manushrestha, Ashwani Kant Bose, Subham Choudhary Guided by Dr. Rakesh Kr Singh (2) Ferrite Magnetic Nanomaterials and applications, presented by Sashank Bhushan Das, Ompriya, Gaurav Kr, Singh Sonu Kumar, Guided by Dr. Rakesh Kr Singh. The Research presentation on Nanosilica from rice husk and their applications awarded 1<sup>st</sup> position in technical education category. While total five best innovative activities were presented. In this occasion faculty member and students of Universities of Bihar, Officers of Hon'ble Governor house, resource persons were present.

### 1.2. University level scientific programme on "Innovations and Entrepreneurship"



Nanoscience students awarded 1<sup>st</sup> and 3<sup>rd</sup> position at University level programme.



### Curricular Aspects and Teaching- Learning and Evaluation

At university level, one day research presentation was organized on the topic "to promote Innovations and entrepreneurship" on 13<sup>th</sup> February 2020. In this scientific activity, total 30 team member of Young innovators from different academic institutions of AKU and PG centers participated. 1<sup>st</sup> and 3<sup>rd</sup> position were secured by students of Nanotechnology center of AKU, Patna, while 2<sup>nd</sup> prize was awarded to students of Katihar Engineering College. The title of the research presentation of nanotechnology center was "Magnetic nanomaterials and their applications for Humanity" and "Nano silica production from rice husk and their possible linkage with industries research for the development of society". Both group of students worked under the supervision of Dr. Rakesh Kr Singh, Head-academic. The panel of judges, who evaluated the research innovations are from NIT Patna, BIT Patna.

#### 1.3. National Workshop on Nano-Engineering Science and Research Advances



Prof. Dinesh Rangappa, Head, Nanotechnology, VTU, welcome by Dr. Rakesh Kr Singh, Head-Academic, Nanoscience center, AKU.



Delegates of National Seminar on Nanoscience Engineering and advance in research

## Curricular Aspects and Teaching- Learning and Evaluation

On 27 August 2019, One-day national workshop was organized at nanotechnology center on 'Nano-Engineering Science and Research Advances (NESARA)' under TEQIP-Twining activities of AKU. Three faculty members from VTU, Bangalore- Dr. Dinesh Rangappa, Dr. Parasana D. Shivaramu and Dr. S.V. Lokesh delivered a lecture in different field of nanoscience and nanoengineering. On this occasion, Head-academic of Nanoscience center, AKU, Dr. Rakesh Kr Singh delivered a talk on ongoing academic cum research activities at ACNN, AKU and Career in Nanotechnology research and its possibilities to linkage with industries for the development of society. 15 Ph.D./ M.Tech students of VTU also participated and presented research paper. Faculty member of ACNN, AKU, Dr. A.K.Jha, Dr. Vijay Kr Ravi, Mr. Atul Mohan also delivered a lecture. 35 students of ACNN, AKU and 15 students of nanotechnology center, VTU participated and presented a research paper in this national workshop.



**Research presentations by M.Tech Students, working under my supervision in international Conference at Bangalore**



**1.4. Visit of Scientific Research Lab of nanoscience center, headed by Dr. Rakesh by students and faculty member, Nanotechnology center of VTU, Bangalore**



Head of the nanotechnology center, Faculty member and Ph.D. students of VTU, Bangalore visited Electrical, Magnetic, Electron Microscopy, Structural and Community science laboratory at Nanotechnology center of AKU. They become very happy from ongoing research activities and learning fundamental principal of science through simple low cost/no cost experiments.

### 1.5. Popular Science Lecture on ‘Astronomy and the mystery of the Universe’

Astronomy and the mystery of the Universe’ is related to Interdisciplinary science subject. This session was organized on 31<sup>st</sup> July 2019. The main speaker was Prof. Rajmal Jain, Former scientist, Physical Research laboratory(PRL) Ahmadabad, Fellow of Royal Astronomical Society and Founder of Udaipur Solar Observatory. On this occasion Prof. K.N.Rai, general secretary Indian Association of Physics(IAPT) was also delivered a lecture for promotion of cutting edge research in the society. Dr. Rakesh Kumar Singh, Head-academic, ACNN, AKU welcome the guest and shared the vision of this academic center. After the session, resource persons also visited the Electron microscopy and magnetic characterization research laboratory.

### 1.6. Popular Science Lecture on Science of small object

On 2<sup>nd</sup> Sep 2019 popular science lecture on Science of small things was organized. On this occasion, Prof. S.R.Hasan Institute of Mathematical Science, Chennai was main speaker and he appreciated the scientific infrastructure and research activities carried out under the leadership of Dr. Rakesh Kr Singh, Head-Academic. Prof. Hasan explained in details how the materials in small size behave differently for various applications. Md. Qamar tanbir, Research scholar coordinated this scientific session.

### 1.7. Teachers day- 2019



Teachers Day-2019



### Curricular Aspects and Teaching- Learning and Evaluation

Teachers day was organized on 5<sup>th</sup> September 2019. On this occasion students and faculty member remembered the vision and mission of Dr. Sarvpalli Radhakrishnan. On this occasion, Dr. Rakesh Kr Singh, Head-academic of nanoscience center addressed students on ethical values in life that foster for sustainable growth. He further shared his ongoing healthy academic activities such as Nanotechnology in food and Ayurvedic science that can give to the new direction of state Bihar and India. Such need based research highlighted the role of teachers for sustainable development. Dr. Kumari Anjana administrative head, nanoscience center also stressed the students to follow the path of ideal teacher. On this occasion, coordinator of River studies, Ms. Minisha Prakash also present. M.Tech and Ph.D. students showed his gratitude for his teachers and welcome with bouquet. Ms. Ompriya, Mr. Gaurav Kr, Mr. Shashank Kr and all M.Tech and Ph.D. students organized the teachers day with full enthusiasm.

#### 1.8. International Conference on "Nanoscience Engineering and Research advances"

From 9<sup>th</sup> Sep 2019 to 11<sup>th</sup> Sep 2019 international Conference on "**Nanoscience Engineering and Research advances**" organized at VTU Bangalore under TEQIP programme. 14 students under coordinatorship of Dr. Rakesh Kr Singh visited and participated in International Conference on "**Nanoscience Engineering and Research advances**" at VTU Bangalore. In two days international conference about more than 150 delegates participated from different parts of world and shared latest research in the field of nanomaterials research. On 2<sup>nd</sup> day, career prospects of nanotechnology research was focussed. All the students of AKU also presented research finding. Dr. Rakesh Kr Singh, Head- Academic of Nanoscience center delivered a talk on "**Ayurvedic Bhasma as Nanomedicine**" and "**Challenges & Opportunities in Nanoscience and Technologies**". On 12<sup>th</sup> Sep 2019, all students with faculty member Dr. Rakesh Kr Singh visited Nanotechnology center of IISc. Bangalore and also met with Prof. Rudra Pratap, Dy-director, IISc. Bangalore. Students were very excited for new research after interaction session with hon'ble Prof. Rudra Pratap and visit of Nanotechnology center.





## Curricular Aspects and Teaching- Learning and Evaluation



IISc Banblore visit



Nanoscience center of AKU academic tour at VTU Banglore and IISc Banglore with Dr. Rakesh Kr Singh, Head-Academic



## Curricular Aspects and Teaching- Learning and Evaluation related activities Organized

### 1.9. Fresher Day organized for M.Tech Session 2019-21 session students



#### **M.Tech students with Faculty member on the occasion of Freshers day**

In session 2019-21 total 19 students admitted in M.Tech Nanoscience and Nanotechnology courses. The basis of admission is written and interview. The fresher programme was organized on 16 November 2019 was M.Tech 2018-20 M.Tech scholars. On this occasion all Faculty member, Head-academic, Dr. Rakesh Kr Singh, Head-Administrative, Dr. Kumari Anjana, Faculty member, staff member were also present and grace the occasion.

### 1.10. Training Programme Organized DLS and Zeta Potential



The high end equipment Dynamic light scattering (DLS) and Zeta Potential are very useful in particle size distribution from micron size to nanoscale and determination of Zeta potential. The Zeta potential related to stability of materials.

### Curricular Aspects and Teaching- Learning and Evaluation

One day hands on training programme was organized on 31<sup>st</sup> Jan 2019. On this occasion, Malvan Company representative specially helped in demonstration of this equipment's. Dr. Rakesh Kr Singh, Head-academic of Nanotechnology center delivered a talk on fundamental principal and applications of DLS and Zeta potential in the field of Nanotechnology and Materials Science. M.Tech session 209-21 scholar participated in this training programme.

#### 1.11.MOU Ceremoney with Atal Incubation center



The MOU between Nanoscience and Nanotechnology center, AKU and Atal Incubation Center of Bihar Vidyapeeth was signed on 18<sup>th</sup> January 2020. On this occasion, Hon'ble Vice Chancellor Dr. A.K.Agrawal appreciated this MOU with Atal incubation center for the benefit of students, faculty member and particularly promotion of research in the society. Sri Vijay prakash, IAS, chairman Vihar Vidyapeeth explained the objectives behind establishment of "Atal Incubation center Patna" for the devolpement of sciencetiife research and innovations. He also emphasized the local reources based research activities. On this occasion, Pro Vice Chancellor Dr. S .M .Karim, Registrar(i/c) Sri Rajeev Ranjan, Adminisrative Head, Dr. Kumari Anjana, OSD(Exam) Sri Ram Ji Singh and Sri Promod Kr Karn from Bihar Vidyapeeth were present and grace the occasion. Dr. Rakesh Kr Singh coordinator of this MOU programme and Head-Academic of nanoscience center presented the mission and vision of this academic center, which is related to cutting edge research of 21<sup>st</sup> century.



## Curricular Aspects and Teaching- Learning and Evaluation

### 1.12. International Women's Day 2019



International Women's Day was celebrated at Nanotechnology center on 8<sup>th</sup> March 2020 focusing social, economic, cultural and political achievements of women. The day also marks a call to action for accelerating gender parity. Dr. Rakesh Kumar Singh, head of Nanoscience center of AKU highlighted the women scientist award for young scholar for nation development. Smt. Dolly Ghosh, Library Assistant and other Women Ph.D. scholar also shared her vision.

### 1.13. Interaction Session with Research Scientists of VIT and IIT Dhanbad

On 26<sup>th</sup> November 2019, IIT Dhanbad students, Md. Anwar given presentation to M.Tech students on role of young people in nanotechnology field. Md. Anwar highlighted the importance nanoelectronics in various area of science and technology. Dr. Vijay Kumar of VIT Vellore delivered a talk on Meta materials and their applications for microwave circuit. Dr. Vijay kumar have specialization in remote sensing applications and shared various new knowledge about nanotechnology applications in the field of remote sensing. In vote of thanks, Academic-head of nanoscience center, Dr. Rakesh Kumar Singh, requested resource person to visit again and ignite our students.

## Curricular Aspects and Teaching- Learning and Evaluation

### 1.14. Kilkari , Dept. of Education, Govt. of Bihar and other Schools students of Bihar visit

Dept. of education, Govt. of Bihar, officially sent a letter for visit of nanotechnology center of AKU, IIT Patna and Sri Krishna Science center, Patna under ministry of culture, Govt. of India for visit of budding scientists. In this regard, kilkari students and other various school students of Bihar visited the nanotechnology lab of AKU. During visit by young minds of schools, they excited to see the fontiers research activities.



Students/Children of different academic Institutions of Bihar is the regular visitors of this Nanoscience center



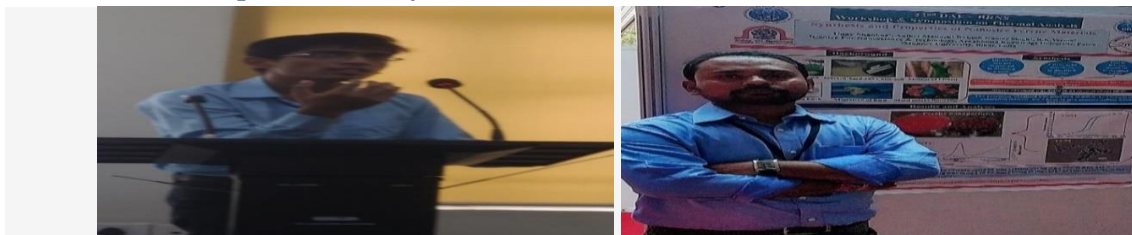
Visited by faculty member of University/ Colleges of Indian universities/ Institutions. These teachers are engaged in orrientation prohramme at Academic Staff college, Patna university.



Group of Students, selected for presentations of innovations in Nanotechnology research under the supervision of Dr. Rakesh Kr Singh.

## Activities Category-II: Students Awards/ Recognitions working under the supervision of Dr. Rakesh Kr Singh

### 2.1. Research presentation/Academic activities



**Abhisekh Kr( M.Tech), Aniket Mansh( Ph.D) and Uday Shankar( M.Tech) presented research activities in National workshop at Munger and BARC Mumbai**

[A].Abhisekh Kr, M.Tech 207-19 session students presented research paper on Hexa ferrite Nanomaterials and their application in National seminar on 11<sup>th</sup> Aug. 2019 at Munger university. Abhisekh Kumar worked on this topic under the supervision of Dr. Rakesh Kr Singh.

[B]. Md. Qamar Tanvir, Ph.D. working on magnetic nanomaterials under the supervision of Dr. Rakesh Kr Singh presented a research on Cobalt Ferrite Nanomaterials in National seminar at V K S University.

[C]. Mr. Harendra Kr Satyapal working on hexa ferrite nanomaterials presented research paper in International conference at Delhi. Mr. Satyapal working for Ph.D. degree under the supervision of Dr. Rakesh Kr Singh

[D] Aniket Manash, Ph.D. scholar 2018-21 and Mr. Uday Shankar, M.Tech scholar 2018-20 presented a research paper at Babha Atomic Research center(BARC) Mumbai on thermal anlysis of Hexa ferrite nanomaterials and their applications. Both students are working under the supervision of Dr. Rakesh Kr Singh.

[E] One group student awarded 1<sup>st</sup> prize at raj Bhawan Patna on 29 Feb 2020 for presenting best research finding in the field of nano silica production from rice husk. Also, at AKU, 2 groups selected. ACNN students awarded 1<sup>st</sup> prize in Inter university level First prize. Both group of students are working on magnetic nanomaterials and nano silica from rice husk for its applications and guided by Dr. Rakesh Kr Singh.

### 2.2. Inspired Award to M.Tech topper of Nanoscience center of AKU

Govt. of India has launched a unique scheme “Innovation in Science pursuit for Inspired Research, fellowship in basic and applied research. Ashutosh kr shortlisted for evaluation at level-II of the selection process. Evaluation of research area of Mr. Ashutosh Kumar by domain experts based on academic merit and research-based profile. Mr. Ashutosh Kumar worked on the topic’ Purification of water through nanomaterials ‘under the supervision of Dr. Rakesh Kumar Singh, Head-academic of the nanotechnology center of AKU



## Students Awards/ Recognitions

### 2.3. Starts Up Workshop Participations

5 students including Siddiqui, Rahul Raman, Prince Kumar, Manushreth, Anuradha muskan of M.Tech 2019-21 participated in AKU starts up workshop under TEQIP-3 programme held at hotel Patliputra Continental Patna. These students gave their presentation on Nanosilica production from rice husk and their possible applications for industrial linkage. The conferences committee chair appreciated their idea and provides necessary support from this scheme.

2.4. BRTC-BIRAC-KIIT Bio NEST and Patna University organize 2 days' National workshop on innovations & Entrepreneurship (Building & Translating innovative ideas) at wheeler senate hall, Patna university. In this workshop 10 M.Tech and Ph.D. students with Academic-Head Dr. Rakesh Kr Singh participated and interacted with national resource person.



**BRTC-BIRAC-KIIT Bio NEST National workshop at Patna**



Nanoscience students presenting research paper in International conference.



External subject expert in M.Tech research Project presentation

## Academic activities category-III

### Planning and Development: Nucleation growth of the center and visionary plan

#### 3.1. Simulation lab in nanomaterials research

Govt. of Bihar, Dept. of education supported the fund for simulation laboratory in nanomaterials research laboratory, which are being established under the coordinator ship of Dr. Rakesh Kr Singh. The software, which are being procured are Molecular Dynamics Simulation (COGNAC, VSOP), Multiphase Materials Simulation (MUFFIN), Visual TCAD and Genius Devices Simulator. The following members are technical specification nominated by the university

1. Dr.P.K.Tiwari, Dept. of Electronics Engineering, IIT Patna
2. Dr.Manoranjan Kar, Dept. of Physics, IIT Patna
3. Dr. Rakesh Kr Singh, Head-Academic, ACNN, AKU(Coordinator)
4. Dr. Neeraj Shukla, NIT Patna
5. Sri Ramji Singh and Dr. Kumari Anjana, Administrative-Head, ACNN, AKU

#### 3.2. M.Sc course in Nanoscience

M.Sc in nanoscience courses is to be start very soon. For this under the coordination of Dr. Rakesh Kr Singh, academic-head, ordinance, syllabus etc. are being prepared and submitted to the University for necessary approval and further action. The following members are appointed by the Hon'ble Vice chancellor for their progress.

#### M.Sc course in Nano science ordinate Committee

Prof. A. Yadav, Former Vice Chancellor Directore( At present) VVIT, Purnea	Member
Dr. Navin Kr Nishchal, IIT Patna	Member
Prof. Rajmani Prasad Sinha, Former Vice Chancellor and Higher Education Council member, Govt. of Bihar	Member
Dr. Rakesh Kumar Singh, In charge-Academic Center for Nanoscience, AKU, Patna	Co-coordinator

#### 3.3. AMC of Nanoscience laboratories

There are 6 Nanomaterials Research laboratories at Nanotechnology centre of Aryabhata Knowledge University, Patna. They are Structural Characterization, Magnetic, Optical, Optical, Synthesis, Microstructural, Electron microscopy laboratory. The establishment and procurement processes were almost completed in the year 2016. After that warranty period completed. All the details of AMC, terms & Conditions, related proposals are being prepared for R & D activities.

### Research and Development activities

#### 3.4. Plan for Transmission Electron Microscope (TEM)

Dr. Rakesh Kr Singh, Head-academic of nanoscience center requested Hon'ble Sri Harivansh, Deputy-chairman, Rajya sabha for contributing financial support for TEM for scientific research in the field of materials science and nanotechnology. Hon'ble Shri Harivansh sir, appreciated the nanomaterials research activities carried out under the leadership of Dr. Rakesh Kumar Singh and objective of Aryabhata Knowledge university, Patna and agreed for help of 6 cr. Rs for procurement of TEM. Hon'ble Vice Chancellor, AKU sent a request letter to Hon'ble Dy- chairman, Rajya Sabha for financial support of procurement of TEM on written request of Dr. Rakesh Kr Singh. This equipment can be used in materials science, basic sciences, engineering science research etc. and even size of the corona virus can be seen through this equipment.

#### Activity Category-IV.

#### Research and Development Activities

The teachers of the center are actively engaged in research and extension services activities and producing vibrant atmosphere of R & D in a state and outside too. In this context following scholars have completed their Doctoral work and present pre-Ph.D. thesis submission presentation successfully.

#### 4.1. Doctoral Research (Ph.D.) awarded/ completed

S.No	Name of Research Scholar	Name of the Supervisor	Area of Doctoral Research
1	Mr. Qamar Tanbir	Dr. Rakesh Kumar Singh	Magnetic Nanomaterials
2	Ms. Sweta Sinha	Dr. Rakesh Kumar Singh	Calcium based Bhasma as nanomaterials and its applications
3	Ms. Archana	Dr. Rakesh Kumar Singh	Food Nanomaterials and its applications
4	Mr. Harendra Kr Satyapal	Dr. Rakesh Kumar Singh	Hexa ferrite Magnetic nanomaterials



### Research and Development activities

**4.2. Doctoral Research (Ph.D.) scholar of academic session 2018-21 assigned their guide and approval obtained through, PGPR and university. They have started their synopsis preparation and also working thesis chapters.**

S. No	Name of Research Scholar	Name of the Supervisor	Field of Doctoral Research( Proposed)
1	Ms. Pallavi Singh	Dr. Rakesh Kr Singh	Functional Food Nanomaterials and its applications
2	Mr. Aniket Manas	Dr. Rakesh Kr Singh	Magnetic Nanomaterials for its applications in Hydroelectric Cell
3	Ms. Pushpa Sharma	Dr. Rakesh Kr Singh	Purification of water through Nanomaterials
4	Mr. Naman Nayak	Dr. Rakesh Kr Singh	Functional Food nanomaterials and its applications
5	Ms. Ritu Kumari	Dr. Rakesh Kr Singh	Functional Herbal based Nanomedicine and its applications
6	Mr. Vivek Kumar	Dr. Rakesh Kr Singh	Magnetic Nanomaterials for its applications in Hydroelectric Cell.

### **4.3.M.Tech Research Project of session 17-19 Completed and awarded degree**

The M.Tech scholar of academic session of 2017-19 completed their research project in following area. The topper of this batch, Mr. Ashtosh Kr worked on purification of water through nanomaterials and selected for INSPIRE award by Govt. of India. Mr. Ashotosh kr worked under the supervision

Name	Guide	Research Topic
1.Monalisa	Dr. Rakesh Kr Singh	Nano Electronics( Magnetic materials)
2.Archana Kumari	Dr. Rakesh Kr Singh	Nano Silica from Rice husk (Agriculture Waste)
3.Farhan Ahmad Khan	Dr. Rakesh Kr Singh	Nano-fertilizer
4.Raj Aryan	Dr. Rakesh Kr Singh	Magnetic Materials( Nano-Electronics)
5.Rakesh Ranjan	Dr. Rakesh Kr Singh	Water Filtration With Nanomaterials
6. Ayush Kumar Jha	Dr. Rakesh Kr Singh	Nano-Pesticides
7.Abhishekh Kr	Dr. Rakesh Kr Singh	Magnetic Materials( Nano-Electronics)
8.Zeeshan Hashmi	Dr. Rakesh Kr Singh	Ferrite Materials (Magnetic Materials)
9.Anurag Kumar	Dr. Rakesh Kr Singh	Nanosilica from Rice husk
10 Ashutosh Kumar	Dr. Rakesh Kr Singh	Water Filtration With Nanomaterials

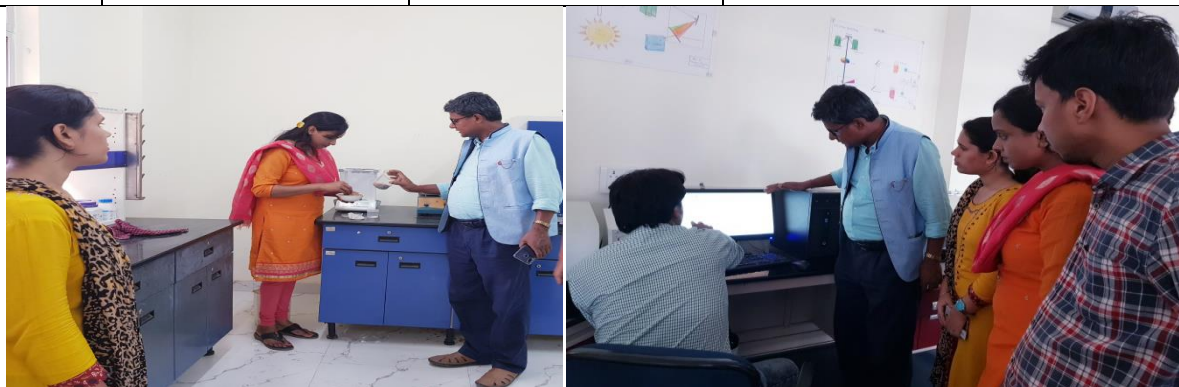
of Dr. Rakesh Kr Singh

### Research and Development activities

#### 4.5.M. Tech Research Project working for project of session 2018-20

The M.Tech Students of session 2018-20 working for their Research Project .Altogether 10 students registered for their research project and all are working under the supervision of Dr. Rakesh Kr Singh. Their supervisors are assigned and approved by PGPR and by university. They are working for their research project.

Sl.No.	Name of the Candidate	Name of the Supervisor	Area of Research project(proposed)
1.	Ms. Om Priya	Dr. Rakesh Kr Singh	Magnetic nanomaterials
2.	Gaurav Kumar	Dr. Rakesh Kr Singh	Nanocomposite and nanoceramics
3.	Singh Sonu Kumar	Dr. Rakesh Kr Singh	Hexa ferrite Nanomaterials
4.	SashankBhusan Das	Dr. Rakesh Kr Singh	Magnetic Nanomaterials
5.	Anjali Kumari	Dr. Rakesh Kr Singh	Nano silica from Rice husk
6.	Shama Frozan	Dr. Rakesh Kr Singh	Multiferroic Materials
7.	Sazid Hussain	Dr. Rakesh Kr Singh	Nanosilica from Rice husk
8.	Golu Kumar	Dr. Rakesh Kr Singh	Magnetic Nano composite
9.	Gokul Kumar	Dr. Rakesh Kr Singh	Magnetic Nanocomposite
10	Uday Shankar	Dr. Rakesh Kr Singh	Nanoscomposite



Preparation of Nano-silica from rice husk by M.Tech students for various applications



Faculty member and students of Nanoscience center, AKU participating in International Yoga day and human chain.

### Research and Development activities

#### 4.6. **Doctoral Research (Ph.D): On going( Registered)**

4 scholar of academic session 2016-19 and 2017-20 are also working their doctoral research. Their work are in progress and they have presented their 2<sup>nd</sup> progress in PGPR, Doctoral committee. Remaining 7 students of this session completed their work and presented their pre-thesis submission presentation.

S.N	Name	Guide/ Supervisor	Research Area
1	BibhutiBikramaditya	Dr. Rakesh Kr. Singh	LuminiscentMaterials( YttriumAluminiumBorateNanomaterials)
2	Dr.Prabhat Kr Dwedi	Dr. Rakesh Kr. Singh	Ayurvedic Bhasma as Nanomedicine

#### 4.7. **Research Projects**

A. Dr. Rakesh Kr Singh, Asst. Prof. cum academic-in charge received research project from Technical Education Quality Improvement (TEQIP) AKU on the topic **“Preparation, Structural, Magnetic and Optical Properties of non Stoichiometric  $K^{1+}/Li^{1+}$  substituted Magnesium Ferrite Magnetic Nano materials as Functional Materials”**. He has submitted 1<sup>st</sup> progress of this project and reported 1 paper in SCI journal for publication.

B. Dept. of Education, Govt. of Bihar granted project on **“Understanding Nature Assisted Teaching in Science”(UNNAT) to National Anveshika Network of India**, coordinated by Prof. H C Verma, IIT Kanpur and Dr.Manoranjan Kar, IIT Patna. Dr. Rakesh Kr Singh is one of the coordinator of National Anveshika Network of India- Patna unit. Responsibilities of Dr. Rakesh are coordinating the different academic activities of this project as resource person as well as coordinator.

C. Dr. Vijay Kumar Ravi, Guest Assistant Prof. **(On contract)** received research grant from Science and Engineering Research Board (SERB), Department of Science and Technology (DST), Government of India on title **“Investigating the Structured Oligomeric Intermediates while aggregation of Disulfide bond dissected Lysozyme and its inhibition strategy”**.

D. In addition to the mentioned project above, at present total no. of M.Tech research project(1 year) and Ph.D.(2 year) are also being carried out in the field of Food nanomaterials, Magnetic nanomaterials, Nano silica production from rice husk as agriculture waste, multiferroic materials, herbal nanomedicine and some others. Total 18 students of this academic session are working under the supervision of Dr. Rakesh Kr Singh, Asst. Prof cum Head-academic of nanoscience center.



## **5. Visitors of the Nano Science Center, AKU, Headed by Dr. Rakesh Kr Singh**

In year 2019-20, the faculty/research scholar of following Institutions visited the Nanotechnology center and appreciated the different academic activities carried out in the nanoscience and nanotechnology center of AKU, Patna.

- Physical Research Laboratory (PRL) Ahmadabad
- Nalanda University Rajgir
- Indian Institute of Technology (IIT) Patna
- Indian institute of Technology, Dhanbad
- Indian Institute of Science Bangalore
- National Institute of Technology Patna
- Visvesvaraya Technological University (VTU) Bangalore
- Vellore Institute of Technology(VIT) Chennai
- Central University of South Bihar
- Birla Institute of Technology
- Cytogene Pvt. Company ltd. Lucknow
- Vihar Vidyapeeth, Atal Incubation centre, Patna
- Indian Institute of Science(IISc) Bangalore
- Indian Institute of Science education and Research(IISER) Bhopal
- Nalanda University, Rajgir
- University of Allahabad
- Central University of Jharkhand
- The Institute of Mathematical Science, Chennai
- Physical Research laboratory(PRL) Ahmadabad
- Indian Institute of Technology (IIT) Madras and some others



Officers of Technical education quality improvement programme from Delhi and I.I.Sc Bangalore visited nanoscience center and ongoing research activities.

## 6. Research Publications of Faculty/Scholar with AKU affiliation

**6.1. Dr. Rakesh Kumar Singh Academic- Head of the nanoscience center,** published/ Accepted research articles in Magnetic Electronics nanomaterials, Nanotechnology in Ayurvedic Bhasma and Nanotechnology in food. The details of research publications published/under review/accepted are following.

1. Structural, optical, magnetic properties of non- stoichiometric lithium substituted magnesium ferrite nanoparticles for multifunctional applications, Journal of Materials Science: Materials in Electronics. <https://doi.org/10.1007/s10854-020-03454-z>.
2. Equilibrium sorption of fluoride on alumina in aqueous solution, J. desalination and water treatment(accepted).doi.10.5004/dwt.2020.26002.
3. Tuning the microstructural, optical and superexchange interactions with rare earth Eu doping in nickel ferrite nanoparticles, J. Materials Chemistry and Physics. 241(2020)122383.
4. Gd- doped soft Mn–Zn nanoferrites: synthesis, microstructural, magnetic and dielectric characterizations, Journal of Materials Science: Materials in Electronics (2020) 31:3529–3538.
5. Effect of doping different rare earth ions on microstructural, optical, and magnetic properties of nickel–cobalt ferrite nanoparticles, Journal of Materials Science: Materials in Electronics. 31 (2020)435–443
6. Effect of flow Co-doping on structural, optical, and magnetic performance of ZnO nanoparticles, Optic, International journal for light and Electronics optics. 203(2020)133966.
7. Low temperature synthesis and influence of rare earth Nd<sup>3+</sup> substitution on the structural, magnetic behaviour of M-type barium hexa ferrite nanomaterials, Materials Today: Proceedings, <https://doi.org/10.1016/j.matpr.2020.01.590>.
8. Calcium oxide (CaO) Nanomaterial (Kukutandatawak Bhasma) from Egg shell: Green Synthesis, Physical Properties and Antimicrobial behaviour, accepted, J. Mater Today: proceedings( 2020)
9. Effect of superfine grinding on Structural, Morphological and Antioxidant properties of Ginger (*Zingiber officinale*) Nano powder, J. Mater Today: proceedings(2020).
10. Sol-gel synthesis, crystalline phase, optical absorption and photoluminescence behaviour of cerium-doped (Ba<sub>0.5</sub>Sr<sub>0.5</sub>)FeO<sub>3-δ</sub> powders) powders, Mater. Res. Express (2019)105520.

### Research Publications of Faculty/Scholar with AKU affiliation

11. Defect Induced room temperature ferromagnetism and enhanced photocatalytic activities in Ni doped ZnO synthesized by Electrodeposition, j.Chinese Physics B(IOP) 2020, accepted.
12. Effect of Fe concentration on Ferroelectric and Magnetic property of Lead iron Niobate, J of electronics Materials (2020). accepted

### 7.1. Professional Development, Co-Curricular and Extension Activities

**Dr. Rakesh Kr Singh of Nanotechnology center, Organized** about 15 seminar/ Scientific activities at Aryabhata Center for Nanoscience and Nanotechnology, Aryabhata Knowledge University, Patna as a coordinator/Convener/ Head-Academic. The focal theme of seminar are related to nanoscience and innovation in science education (Mentioned in activity category-I). Some more academic activities organized by Dr. Rakesh Kumar Singh are following

- 7.2. **National Anveshika Experimental Science Skill Test (NAEST)-2019**  
**National Science Experimental Skill Test: Screening and prelims**  
**Innovative Practices**



**Dr. Rakesh Kr Singh** was Coordinator **National Anveshika Experimental Science Skill Test (NAEST)-2019** organized for Colleges, Universities and Schools students. This is unique programme for skill development in science experiment for inspired research. Prof.H.C.Verma, IIT Kanpur is National coordinator of NAEST. About 400 students participated in this national science skill test and Patna based 47 academic institutions students participated. The screening and prelims of National Science skill test was held at dept. of Physics, Science College, Patna university. This is unique programme for inculcate the culture of learning science through experiment and appreciating science in daily life. This skill test was organized in 26 places of this country, which was coordinated by Padamshree, Prof. H.C.Verma, IIT Kanpur. This programme has been organized under the agies of National Anveshika Network of India . Patna Anveshika was coordinated by Dr. Amarendra



Narayan of Patna university and Dr. Rakesh Kr Singh of Aryabhata Knowledge university, Patna. Beyond class room activities related to science and encourage young mind for science education is the main objective.

### **National Science Skill Test- Brief introduction**

Experiments are integral part of science. History shows how careful observations and suitably designed experiments have changed the course of human development in all aspects. To promote these skills among students, National Anveshika Network of India (NANI), a unit of Indian Association of physics Teachers, conducts a competition NAEST (National Anveshika Experimental Skill Test) based on Physics Experiments each year since 2014. This is probably the only test of its kind in India. In the First round which is called Screening Round, 8 to 10 short videos of some innovative experiments will be shown to the students and questions will be asked to test their observation skills and basic understanding of the subject. Selected students from the Screening round will be allowed in the Prelims round which will be conducted by the Anveshikas. This round focuses more on performing experiments and analyzing the data by the participants

### **7.3. Dr. Rakesh Kr Singh Participated** in following professional/academic activities

- (i) State level Balsri programme -2019 on 29-30 July 2019 on focal theme, Creative Scientific Innovations, Organized by Dept. of Kilkari, Autonomous unit of Dept. of Education, Govt. of Bihar
- (ii) Valued guidance as resource person for the enrichment of national project (A programme of DST-Govt. of India) for state awardee, at SCERT, Govt. of Bihar, Patna, Dated-2<sup>nd</sup> Dec. 2019, at Madhubani Bihar.
- (iii) As Joint secretary of Indian Association of Physics Teachers (IAPT) and Jt. Coordinator of National Anveshika Network of India (NANI) participated in meeting (generally on Sunday or holiday) of different activities of Physics Education and emerging frontiers research
- (iv) Participated NAAC workshop at Raj bhavan, Patna on June 2019 on 12<sup>th</sup> June 2019
- (v) Participated as Senior Resource person at IIT Guwhati, 8-11<sup>th</sup> June 2019, organized by center for Excellence in Science and Mathematics Education, Pt. Madan Mohan Malaviya National Mission on Teachers and Teaching, IIT Guwahati.
- (VI) Participated in 21 days orientation programme at academic staff College, Patna University, date- 29<sup>th</sup> Nov to 19<sup>th</sup> Dec 2019.

### **Professional development activities of Dr. Rakesh Kr Singh**

- (VII) Participated as stakeholder meeting organized by DST-UKIERI International project on recent update of nature and nurture in arsenic induced toxicity in state Bihar on 13<sup>th</sup> Sep 2019, organized by Bihar pollution control board, Govt. of Bihar.
- (VIII) Participated as organizing committee member on the occasion of Medha Divas, organized by BSEB, Patna on 3<sup>rd</sup> Dec. 2020. In this programme eminent scientist Dr. R K Kotnala, CSIR-NPL delivered a talk on hydroelectric cell invention, made by him
- (IX) Participated in Sensitization Workshop for promotion of research in the universities of Bihar, under the aegis of Raj Bhavan, Patna, date-29<sup>th</sup> May 2019.
- (X) Participation in annual general body meeting of science for society on 10<sup>th</sup> June 2019 at Science College, Patna University (The main agenda of this meeting was- Presentation of annual report, future Scientific activities and any some organizational issue. The focal theme-Science, Technology and Innovation for a clean, Green & Healthy Nation was discussed in detail)
- (XI) Workshop on intellectual property right and patent filings on 1<sup>st</sup> Dec 2019, Organized by Aryabhatta Knowledge University and some others such activities
- (XII) BRTC-BIRAC-KIIT Bio NEST and Patna University organize 2 days' workshop on innovations & Entrepreneurship (Building & Translating innovative ideas) at wheeler senate hall, Patna university. In this workshop 10 M.Tech and Ph.D. students with Academic-Head- Dr. Rakesh Kr Singh participated and interacted with national resource person.

**Activity Category. VIII. Contribution to Corporate Life and Management of the Department and Institution through participation in academic and Administrative Committees and responsibilities (Rakesh Kr Singh)**

In addition to his engagement in teaching, research, research supervision, professional development activities, **Dr. Rakesh Kr Singh** engaged in following corporate life and management of the university and department. In this process, he has worked on about 400 files and and 300 letters, related to different affairs of development of nanoscience center and AKU.

<b>Detail of the events/Work</b>	<b>Responsible Committee Member</b>
1. Aryabhatta Centre for Nanoscience and Technology, Aryabhatta Knowledge University, Patna,	In charge-Academic (Responsible for Teaching, Research-Laboratories, admission, Examination, attendance and related administrative activities)
2.Doctoral Committee, Post-Graduate Programme in Research, Aryabhatta center for Nanoscience and Nanotechnology 3.Equivalence Committee of AKU 4. M.Sc course in Nano science and Technology ordinance and Syllabus of AKU 5. Vedbhaw Nirodhak Officer of Aryabhatta Knowledge University 6. Anti-ragging committee member-AKU 7. 7. Astronomy and Astro Physics course at AKU 8. MOU of CNN, AKU with Atal Incubation Center, Bihar Vidyapeeth, Patna 9. Simulation Laboratory Establishment at Nanoscience center, AKU	<b>Convener</b> <b>Coordinator/ Nodal Officer</b>
<b>As member of different committee such as</b> 11. Blue Print of higher education in state Bihar- preparation of report, as suggested by Hon'ble Governor of Bihar. 12. Selection Committee member of Senior Technical Assistant at AKU, Patna 13. Framing draft for rules and regulation for scholar hostel of AKU 14. Mental humiliation problems solution committee member, as suggested by Bihar state minority commission. 15. Member of IQAC cell of AKU 16. Devolvement of different affairs of new campus of AKU 17. Quotation Opening Committee member of ACNN, AKU 18. Preparation of format of prospectus-2019/Hand-book of AKU 19. Preparation of Intellectual Property Right (IPR) law of the university. 20. Identification of funding agency and Research promotion cell for research at AKU 21. Inspection committee member of AKU, affiliated Colleges 22. Welfare Committee 23. Act and Statue revision committee 24. Welfare Committee, Post-creation, absorption and confirmation 25. Different affairs of devolvement of new campus of AKU 26. Under Member of Statute Regarding Governing Body of AKU, participated as university representative of higher education institute- Chanakya Foundation, B.Ed. College Khagaul, Patna and Indian Institute of Yoga, Patna	<b>Committee Member</b>



## **Activity Category IX.**

### **Engaging as a Resource person/ Lecture delivered/ paper presented / As subject expert (By Dr. Rakesh Kumar Singh)**

**A.Dr. Rakesh Kr Singh, Asst. Prof & Head-Academic, University Center for Nanoscience & Nano Technology** delivered an Invited talk/ Research presentations total 26 places across the country in various conferences/ workshops/ seminars. The details of place and events are followings-

1. Delivered talk on ‘Nanosilica production from Rice husk and their Applications for global business’ as a resource person in International Conference on ‘Materials for Environment, Sustainable Society and Global Empowerment’ at Visvesvaraya Technological university(VTU) Bangalore, dated 20<sup>th</sup> Dec. 2019.
2. Participated as external subject expert for JRF interview, nominated by Director-UGC-DAE CSR Indore for the selection of JRF in UGC,DAE, CSR sponsored project at Dept. of Physics, NIT Patna, date 23<sup>rd</sup> Dec 2019.
3. Delivered a Talk on Ayurvedic Bhasma as Nanomedicine in National Conference on Recent Approaches in Herbomineral Drug Standardization, at Govt. Ayurvedic College, Dept. of Health, Govt. of Bihar, Date- 26<sup>th</sup> Dec. 2019.
4. Delivered talk on Superparamagnetic nature of Bhasma Nanoparticles and their health effect in National Seminar on Science, Yoga and Innovations: Transforming higher education through Knowledge interface on 22 August 2019 at Munger University.
5. Participated as external subject expert for evaluation of the performance of the candidate in the aptitude test and communication skill of trainee education at S K Science center, Ministry of Culture, Govt. of India, date 28<sup>th</sup> Nov. 2019.
6. Participated as face to face programme of scientist with child scientist and resource person for scout teachers on learning Physics through experiment at Madhubani district of Bihar in programme in 27<sup>th</sup> state Children Science Congress-2019: A programme of DST-Govt. of India.
7. Dr. Rakesh Kr Singh was a resource person in BCST-DST Govt. of Bihar project committee Committee member in subject Policy guide lines for supporting grass-root innovators to convert their innovative ideas into prototype model of Govt. of Bihar, dated 27<sup>th</sup> August 2019.
8. Attended as expert on panel discussion on Gold nanomaterials and their efficacy for pregnant women at Govt. Ayurvedic College, Dept. of health, Govt. of Bihar, dated 29<sup>th</sup> Feb 2020.

## **Engaging as a Resource person/ Lecture delivered/ paper presented/Subject expert (By Dr. Rakesh Kumar Singh)**

9. Delivered a talk in UGC-Refresher-HRDC refresher course in Physics at academic staff College, Patna University on Industrial development of society through Nanotechnology based research, date- 20<sup>th</sup> Jan 2020.
10. Delivered a lecture on Ancient Indian wisdom and Scientific evidence in National seminar on Ancient history, Culture and archiology, Dept. of History, Patna University on 21<sup>st</sup> Jan 2020.
11. Participated as general body meeting of Science for Society Bihar, member-NCSTC-DST, Govt. of India as professional member of this scientific society at Science College, Patna university on 16<sup>th</sup> June 2019.
12. Invited speaker on Nanotechnology on Superfine food nanopowder and their application in Internatinal Conference on Nanotecnology: Challenges and Opportunity at VTU-Banglore, date 10<sup>th</sup> Sep. 2019.
13. Research paper presented on Hexa ferrite nanomaterials and their applications in International Conference on Nanotechnology, Renewable Materials Engineering & Environmental Engineering at Industrial Electronics and Electrical Engineers forum, Kolkata, date- 14<sup>th</sup> July 2019.
14. Invited speaker on Innovative method of teaching-Learning Physics through low cost experiments in Orientation programme of Engineering graduate at NSIT-Bihta, on 20<sup>th</sup> Aug 2019.
15. Invited speaker in Naional workshop on Nanoscience Engineering and Research advances under TEQUIP project at AKU, Patna , date 27 Aug. 2019.
16. Invited resource person on Training on Employability Skills and Technical Talks: Joint workshop of students and faculty of VTU-Banglore and AKU-Patna, dated 28<sup>th</sup> Aug. 2019.
17. Invited speaker in a workshop on health awareness and medical instrumentation at Mahavir Research-Cancer Institute, Patna on 20<sup>th</sup> July 2019. The topic of lecture in health and Enginnering.
18. Delivered a talk as Invited speaker in International Conference at Delhi on 20<sup>th</sup> Feb 2020 on Monovalent substituted Spinel ferrite and Hexa ferrite nanomaterials for Electronics indusdries.

## **Engaging as a Resource person/ Lecture delivered/ paper presented (By Dr. Rakesh Kumar Singh)**

19. Invited speaker in teachers-students workshop of POLLEX-TIV-Science Workshop in theory and experiment at Patna. This workshop was organized by Asian development educational & research foundation(ADERF) & Asian Physics Olympiad cell, date-28<sup>th</sup> May 2019.
20. Attended as Ethical Committee member of M.D. courses in Ayurveda Science in Post-Graduate Department of Ayurveda Science, Govt.of Ayurveda, Dept. of health, Govt. of Bihar.
21. Contributed in NAAC related activities at Dept. of Physics, Patna University as a part time deputation to assist Patna university for accreditation. I was invited as an alumuns of this old university, where I helped to assist the establishment of nanotechnology research activities and establishment of nanomaterials lab during year 2005-2008.
22. Attended five times as expert committee member of BCST-DST, Govt. of Bihar as project peer review committee for faculty and scholar of institutions of Bihar.
23. Delivered a talk as resource person in National workshop on ‘ Nanoscience Engineering and Research advances’ at AKU on 23<sup>rd</sup> Aug 2019, organized under TEQIP-AKU scheme. The topic of lecture was ‘ Possibilities of Industries through resources and research in society’- A road map: My experiences.
24. Worked as editorial board member of various peer reviewed journals.
25. Dr. Rakesh Kr Singh, was joint organizing secretary of 8<sup>th</sup> Bihar science conference(An international conference on Science and Technology),organized by Patna university and BBrain development society, Patna.
26. Participated as one of the subject expert in Science rally on the occasion of national science day-2020 , organized by S.K.Science center, gandhi maidam and SCERT- Dept. of education, Govt. of Bihar.



Dr. Rakesh Kr Singh of Nanotechnology center of AKU, felicitated as resource person by Prof. A.k.Singh, former director, IIT Bombay in National conference.



**Engaging as a Resource person/ Lecture delivered/ paper presented (By Dr. Rakesh Kumar Singh)**



Panel discussion on nanomedicine



Felicitated in National Conf. at Munger Univ



Participation in Science Rally



Delivering a Lecture on Nanomedicine



Felicitated as Resource Person in international Conference at VTU Bangalore



Falicitated in international Conference



Delived a talk on learning methodology

**TEQUIP officials from IISc Bangalore and Delhi visited the Nanoscience Center. On this occasion Dr. Prof. A.K.Agrawal, Hon'ble Vice Chancellor, AKU, Prof. S. M.Karim, Hon'ble Pro Vice Chancellor, AKU, Dr. Rakesh Kr Singh, Head- Academic of the Nanotechnology center, AKU were also accompanied with them.**



Students of Nanoscience center with president of Indian Science Congress President



# एकेयू व अटल इन्क्यूबेशन सेंटर के बीच एमओयू साइन



एमओयू साइन करने के दौरान मौजूद अतिथिगण .

**पटना.** आर्यभट्ट नॉलेज विवि (एकेयू) के नैनो साइंस व नैनो टेक्नोलॉजी केंद्र और अटल इन्क्यूबेशन सेंटर, बिहार विद्यापीठ के बीच शनिवार को एमओयू साइन हुआ. अवसर पर कुलपति डॉ अरुण कुमार अग्रवाल ने एमओयू के प्रयासों की सराहना की. उन्होंने कहा कि इससे शोध व शैक्षणिक गतिविधियों को बल मिलेगा. नैनो साइंस व नैनो टेक्नोलॉजी के हेड डॉ राकेश कुमार

सिंह ने केंद्र की ओर से चल रहे शोध कार्यों के बारे में विस्तार से जानकारी दी. उन्होंने कहा कि एमओयू का मुख्य उद्देश्य स्टार्टअप को सहयोग करना व नैनो टेक्नोलॉजी के क्षेत्र में उद्यमिता के प्रति रुझान पैदा करना है. बिहार विद्यापीठ के अध्यक्ष विजय प्रकाश ने पेटेंट, उत्पाद की संभावनाओं व विश्व स्तर पर हो रहे इस तरह के कार्यक्रम से अवगत कराया.



सेमिनार को संबोधित करते आर्यभट्ट ज्ञान विश्वविद्यालय के डॉ राकेश कुमार सिंह व उपस्थित अतिथि प्रतिनिधि > मुंगेर

मुंगेर विश्वविद्यालय द्वारा आयोजित दो दिवसीय राष्ट्रीय सेमिनार गुरुवार को समाप्त हो गया. सेमिनार के अंतिम दिन तीन चरणों में कार्यक्रम आयोजित किये गये. इसमें प्रथम चरण में योग पर बाहर से आये योगाचार्यों द्वारा चर्चा की गयी. इसके बाद टैक्निकल सेशन का आयोजन किया गया. इसमें आइआइटी पटना के नवीन कुमार निथल एवं आर्यभट्ट ज्ञान विश्वविद्यालय पटना के डॉ राकेश कुमार सिंह सहित कई अन्य शोधकर्ताओं ने अपने शोधपत्र को प्रस्तुत किया. वहीं टैक्निकल सेशन के बाद बीआरएम कॉलेज की छात्राओं सहित कई अन्य कलाकारों द्वारा सांस्कृतिक कार्यक्रम का भी आयोजन किया गया. कार्यक्रम में मंच का संचालन डॉ भवेशचंद्र पांडेय ने किया. जबकि कुलसचिव कर्नल विजय कुमार ठाकुर ने धन्यवाद ज्ञापन किया.

**आयुर्वेद व मेडिसीन के क्षेत्र में नैनो टेक्नोलॉजी का इस्तेमाल :** आर्यभट्ट ज्ञान विश्वविद्यालय के डॉ राकेश कुमार सिंह ने आयुर्वेद एवं मेडिसीन के क्षेत्र में नैनो टेक्नोलॉजी के इस्तेमाल पर चर्चा करते हुए बताया कि 21वीं सदी नैनो सदी बनने जा रही है. आज वस्तुओं के आकार को छोटा और मजबूत बनाने की होड़-सी मची हुई है. विभिन्न क्षेत्रों में नैनो तकनीक विकसित करने के लिए दुनिया भर में बड़े पैमाने पर शोध हो रहे हैं. अति सूक्ष्म आकार, बेजोड़ मजबूती और टिकाऊपन के कारण इलेक्ट्रॉनिक्स, मेडिसिन, ऑटो, बायोसाइंस, पेट्रोलियम, फॉरेंसिक और डिफेंस जैसे तमाम क्षेत्रों में नैनो टेक्नोलॉजी की असीम संभावनाएं बन रही हैं. नैनो प्रौद्योगिकी की विद्यमान विज्ञान का नैनो स्केल में विस्तारीकरण या विद्यमान विज्ञान को एक नये आधुनिक शब्द में पुनर्निर्धारित कर रहा है. वहीं आयुर्वेद

एवं मेडि... टेक्नोलॉ... है. इससे... टेक्नोलॉ... इलाज वि... सेशन में... शोधकर्ता... को प्रस्तु... **आर्टिफि... युवनाए... पटना से... आर्टिफि... करते हु... क्रिप्टोग्रा... द्वारा इन्... सीक्रेट... है, जि... इनफार्मे... की इस... है. जब... ओरिजि... डिफ्रिप्...**

**पीपीयू. नेट-जेआरएफ को मिलाकर बनेगी पीएचडी के नियम**



## एकेयू के नैनोसाइंस डिपार्टमेंट में हुए कई रिसर्च पटनाइट्स की लाइफलाइन बदल देगी नैनोसाइंस

**i SPECIAL**

shambhukant.sinha@inext.co.in  
हेल्थ के क्षेत्र में नैनोसाइंस संजीवनी के तौर पर सामने आ रहा है. इससे पटनाइट्स की लाइफलाइन बदलने वाली है. जहां कई जटिल बीमारियों के लिए लोगों को विकल्प नहीं मिल पाता था. वहीं, नैनोसाइंस में हुए डेवलपमेंट से विकल्प मिल रहा है. पटना स्थित आर्यभट्ट नॉलेज यूनिवर्सिटी के नैनोसाइंस डिपार्टमेंट में नैनोमेडिसीन और इसके अप्लीकेशन पर कई रिसर्च हुए हैं. ये रिसर्च इस क्षेत्र में बड़ी उपलब्धि हैं. जिसे राष्ट्रीय और अंतरराष्ट्रीय स्तर पर भी सराहा गया है. अब तक हल्दी, करैला, अंडा के सेल सहित कई प्रकार के मेटल पार्टिकल पर भी रिसर्च हुए हैं और मेडिकल जगत सहित अन्य क्षेत्रों में इसका असर पता चला है. इसमें से कई रिसर्च देश के अन्य प्रतिष्ठित संस्थानों के साथ मिलकर भी किया गया है.

### इनमें नैनोसाइंस कारगर

- कैसर ● रिक्त डिजीज
- डायबिटीज ● अलजाइमर
- टीबी



### आम मेडिसिन से अलग है 'नैनो'

नैनोसाइंस डिपार्टमेंट के एकेडमिक हेड डॉ. राकेश कुमार सिंह ने बताया कि जहां आम मेडिसीन का प्रभाव पूरे शरीर पर होता है जबकि नैनोमेडिसीन का प्रभाव जहां समस्या है केवल वही बेहद सटीक तरीके से होता है. आयुर्वेद के भस्म बनाने में भी नैनो साइंस का ही अप्लीकेशन है.

### टीबी के बैक्टीरिया पर वार

नैनोसाइंस डिपार्टमेंट में टीबी की बीमारी के लिए जिम्मेदार खतरनाक बैक्टीरिया की वृद्धि को रोकने में मदद मिली है. यह बैरियम हेक्सा फेराइट के नैनो पार्टिकल के अप्लीकेशन पर रिसर्च करने के बाद संभव हो सका है. रिसर्च में पाया गया कि यह टीबी से संबंधित मल्टी ड्रग रेसिस्टेंट यानि एमडीआर की समस्या का तोड़ निकालने में कारगर है. डॉ. अभय कुमार अमन ने बताया कि एमडीआर के मामले में कोई ड्रग टीबी के रोगी पर काम नहीं करता है वही, बैरियम हेक्सा फेराइट में मौजूद चुम्बकीय गुणों से इसके बैक्टीरिया की वृद्धि को रोकने में सकारात्मक परिणाम मिले. रिसर्च टीम में, डॉ. राकेश कुमार, डॉ. अभय कुमार, अर्पिता भट्ट, वीरन मिश्रा, पीके सेठ और प्रो टीएन ढोल शामिल रहे.



### कैसर सेल को खत्म करती है हल्दी

हल्दी के नैनो पार्टिकल से डायबिटीज में भी अच्छे परिणाम मिले हैं. लैब में हल्दी के छोटे-छोटे टुकड़े को नैनो पाउडर में बदला गया. इस दौरान इसके पार्टिकल साइज का अध्ययन किया गया. इसके सैपल को महावीर कैसर संस्थान और पैजीआई लखनऊ में भेज दिया गया. इसकी टैरिंट चूहों के कैसर सेल पर किया गया. इसमें यह पता चला कि यह कैसर सेल नष्ट करने में कारगर है.



### कटैला भी असरदार

एकेडमिक हेड डॉ. राकेश कुमार सिंह और रिसर्च स्कॉलर रहे डॉ. अभय कुमार अमन ने बताया कि करैला का नैनोपार्टिकल डेवलप किया गया, जो कि सामान्य करैला का मॉलीब्डेनम स्ट्रक्चर से बिल्कुल भिन्न पाया गया. इसके नैनो पार्टिकल कैसर के सेल को ग्रोथ करने से रोकने में सहायक है. रिसर्च के दौरान जैसे-जैसे इसका पार्टिकल छोटा किया गया तो पता चला कि इसकी चुम्बकीय शक्ति बढ़ती गई.



नैनोसाइंस के कई अप्लीकेशन हैं. मेडिसीन में इसकी टारगेट और इफेक्टिव डिलेवरी इसकी खासियत है. यहां डिपार्टमेंट में कई बेसिक रिसर्च हुए हैं और इससे नए रिसर्च में भी मदद मिलेगी. डॉ. राकेश कुमार सिंह, एकेडमिक हेड, नैनोसाइंस डिपार्टमेंट, एकेयू

सगाष्ठा • आयुवादाक कालज अस्पताल म बाल डा. राकेश सिंह

# आयुर्वेद भस्म के सेवन से नहीं होता कोई कुप्रभाव

हेल्थ रिपॉर्टर | पटना

शास्त्रोक्त बने अयुर्वेद भस्म में नैनो कण होते हैं, जिससे उसकी कार्यक्षमता बनी रहती है और उसका साइड इफेक्ट नहीं होता है। अयुर्वेद में वर्णित भस्म यदि सही तरीके से तैयार किया गया है, तो उसके सेवन में कोई नुकसान नहीं होता, बल्कि काफी लाभ होता है। इस पर रिसर्च भी हुआ है। आयुर्वेदिक भस्म को लेकर कई तरह की भ्रांतियां लोगों में हैं। कहा जाता है कि इसके सेवन का कुप्रभाव विभिन्न अंगों पर पड़ता है। लेकिन ऐसी बात नहीं है। यह कहना है आर्यभट्ट ज्ञान विश्वविद्यालय के डॉ. राकेश कुमार सिंह का। ये राजकीय आयुर्वेदिक कॉलेज अस्पताल में राष्ट्रीय संगोष्ठी में नैनो टेक्नोलॉजी और अयुर्वेदिक भस्म पर व्याख्यान दे रहे थे। गुवाहाटी के डॉ. आस्के शर्मा,



राजकीय आयुर्वेदिक कॉलेज अस्पताल में संगोष्ठी में शामिल डॉक्टर।

### चिकित्सकों की नैनो कण से संबंधित भ्रांतियां भी हुई दूर

प्राचार्य डॉ. दिनेश्वर प्रसाद ने कहा कि इस सम्मेलन से चिकित्सकों का काफी ज्ञानवर्धन हुआ है। इसके अलावा नैनो कण से संबंधित भ्रांतियां भी दूर हुईं। अगला राष्ट्रीय सम्मेलन जुलाई 2020 में होगा। गुरुवार को आयोजित सत्र में चेयरपर्सन के रूप में डॉ. महेंद्र प्रसाद सिंह, डॉ. अखिलेश कुमार सिंह, डॉ. एमरस गुप्ता, डॉ. नगेन्द्र सिंह, डॉ. श्री भगवान सिंह, डॉ. अरुण कुमार सिंह थे। इस मौके पर डॉ. राधु शरण, डॉ. विजेंद्र, डॉ. मनोज कुमार, डॉ. रविरंजन प्रसाद, डॉ. गौस, डॉ. सुराज कुमार, डॉ. सुमेश्वर सिंह आदि मौजूद थे।

डॉ. राजीव कुमार राम ने दवाओं की गुणवत्ता, ड्रग्स एक्टिंग के पेटेंट और ड्रग स्टैंडर्डाइजेशन में सुमेश्वर सिंह आदि मौजूद थे। डॉ. अभय कुमार ने औषधियों की गुणवत्ता, ड्रग्स एक्टिंग के पेटेंट और ड्रग स्टैंडर्डाइजेशन में सुमेश्वर सिंह आदि मौजूद थे।



# कैम्पस

आज का दिन 1914 में प्रथम विश्व युद्ध के दौरान ब्रिटेन ने ऑस्ट्रिया-हंगरी पर हमले का एलान किया।

## हल्दी नैनो पावडर से पानी में मौजूद आर्सेनिक होगी दूर

**अच्छी खबर**

आर्यभट्ट ज्ञान विश्वविद्यालय (एकेयू) के नैनो टेक्नोलॉजी एवं नैनो साइंस सेंटर को हल्दी के नैनो पावडर से पानी में मौजूद आर्सेनिक को दूर करने में सफलता हासिल हुई है। यहां पिछले पांच सालों से शोध कर रहे शोधार्थियों ने पाया कि हल्दी के नैनो पावडर से भी पानी में मौजूद खतरनाक आर्सेनिक तत्व को दूर किया जा सकता है। ऐसे में पानी से आर्सेनिक दूर करने का एक और तरीका ईजाद हो गया। यहां के उत्साहित शोधार्थी अब इसका पेटेंट कराने की तैयारी कर रहे हैं।

अब तक जितने भी पानी को आर्सेनिक मुक्त करने वाली तकनीक हैं, वो महंगे हैं और पर्यावरण पर भी प्रतिकूल असर डालते हैं। ऐसे में आर्यभट्ट ज्ञान विश्वविद्यालय ने एक नई ईको फ्रेंडली राह खोल दी है। शोध टीम में एकेयू के पूर्ववर्ती छात्र डॉ. अभय कुमार अमन, एमटेक के छात्र आशुतोष और राकेश रंजन शामिल हैं। नैनो टेक्नोलॉजी एवं नैनो साइंस सेंटर के प्रभारी डॉ. राकेश कुमार सिंह ने बताया कि अब इस शोध का पेटेंट हासिल करने के लिए लीटर पानी में आर्सेनिक मिलाने का प्रयोग किया गया। इस दौरान इस बात का ख्याल रखा गया कि भूजल में अभी तक अधिकतम जितना आर्सेनिक होता है, उतना आर्सेनिक हो। अर्थात् उतना आर्सेनिक ही पानी में मिलाया गया, जितना आर्सेनिक प्रभावित इलाके में भूजल में पाया जाता है। अब इस आर्सेनिकयुक्त पानी में दोनो साइज का नैनो पावडर अलग-अलग मिलाया गया। पानी को हिलाकर 10-10 मिनट छोड़ दिया गया। उसके बाद पुनः पानी को फिल्टर करके नैनो पावडर को अलग छान लिया गया।

अब जब पानी में आर्सेनिक की मात्रा मापी गई तो आश्चर्यजनक रूप से क्रमशः 10 गुना और 20 गुना तक आर्सेनिक कम हो गया। जिस पानी में बड़ा आकार का नैनो पावडर था, उसमें आर्सेनिक की मात्रा 10 गुना घटा। वहीं कम आकार वाले नैनो पावडर के पानी में 20 गुना तक आर्सेनिक घट गया। पानी में आर्सेनिक की मात्रा इस स्तर तक आई कि उसे सीधे पीया जा सकता है। ज्ञात हो कि बिहार के गंगा व कोशी क्षेत्र में भूजल में काफी अधिक मात्रा में आर्सेनिक मौजूद है। पटना में भी यह समस्या है।

**एकेयू में ईजाद**

- नैनो टेक्नोलॉजी एवं नैनो साइंस सेंटर में चल रहा था शोध
- शोध के लिए हल्दी का दो नैनो साइज पावडर बनाया गया
- शोधार्थी अब इसका पेटेंट कराने की तैयारी में जुटे

**05** सालों से आर्यभट्ट ज्ञान विवि के छात्र शोध करने में जुटे थे

**01** लीटर पानी में आर्सेनिक मिलाने का प्रयोग किया गया

**फिल्टर करने की मौजूद तकनीक**

चुंबकीय नैनो मटेरियल्स, रिटर्स आसमोसिस आदि।

आवेदन किया जाएगा।

**10 से 20 गुना घट गया आर्सेनिक:** शोध के लिए हल्दी का दो नैनो साइज पावडर बनाया गया। फिर एक-एक

## नैनो टेक्नोलॉजी की पढ़ाई का हब बनेगा आर्यभट्ट नॉलेज विवि

संवाददाता ः पटना

आर्यभट्ट नॉलेज विवि (एकेयू) में इन दिनों विद्यार्थी पर कब्जे घमाने का काम चल रहा है। अभी विवि में नैनो टेक्नोलॉजी का इंट्रोडक्शन लेब है, जिसे पर विवि काफ़ी ध्यान दे रहे हैं। ऐसा इसलिए क्योंकि पटना में अब नैनो टेक्नोलॉजी की पढ़ाई का हब एकेयू बन रहा है, जहां नैनो टेक्नोलॉजी में एमटेक के साथ एमएससी को पढ़ाई हो रही है साथ ही विद्यार्थी का काम हो रहा है। एकेयू के कुलपति प्रो. अरुण कुमार अग्रवाल ने कहा कि उच्च और अत्याधुनिक शिक्षा उपलब्ध करवाया जा रही है। सेंटर के नैनो साइंस एंड नैनो टेक्नोलॉजी (सोएनएन) भवन के पूर्वी क्षेत्र में अपनी तरह का एक मात्र केंद्र है। इसने विश्वस्तरीय लेब, उद्योग केंद्र

विशेष कार्यक्रम तथा अत्याधुनिक अनुसंधान केंद्र के जरूरत पहचान बनवाये हैं। संस्थान के लिए अनुभव पर अतिरिक्त शिक्षार्थी और कर्मचारियों को नियुक्ति की गयी है। प्रयोगशाला पर स्थान दिया जा रहा है। इसमें न केवल नवे ज्ञान के निर्माण में योगदान मिल रहा है, बल्कि छात्रों को परियोजना प्रतियोगिताओं को हल करने के लिए प्रेरणा भी मिल रही है। नैनो टेक्नोलॉजी के लेब डॉ. राकेश कुमार सिंह ने कहा कि नैनो टेक्नोलॉजी में छोटे परियोजना पर शोध किया जाता है। कुलपति प्रो. अरुण कुमार ने कहा कि विवि में नैनो साइंस एंड नैनो टेक्नोलॉजी को डिजिटलाइज्ड किया जा रहा है। विवि में नैनो साइंस की उच्च गुणवत्ता का मूल्यांकन डिजिटल रूप से किया जा रहा है। स्टूडेंट्स को अब डिप्टी ऑनलाइन भी जगहों।

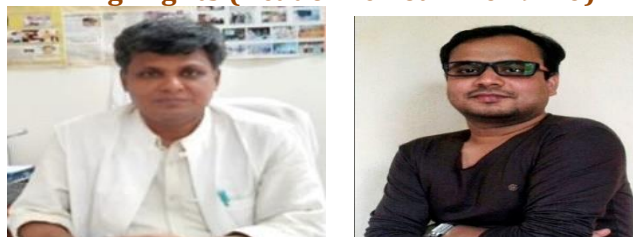


Faculty member of Nanoscience center participating, In Skill /Employability workshop under TEQIP



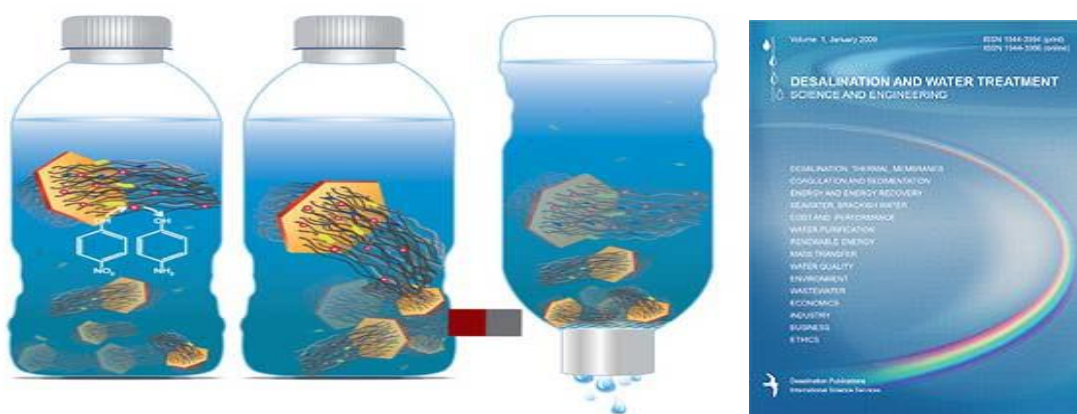
Faculty are felicitated as resource person in international Conference.

**Research Publications in academic Year 2019-20: Highlights (page 36-48)**  
**Research publication by faculty/scholar with Nano science center of AKU affiliation**  
**Highlights (Academic Year: 2019-20)**



**Research Team – Dr. Rakesh Kumar Singh, Dr. Abhay Kr Aman et. al**

**Title of research- Purification of water through activated Alumina materials accepted in SCI Journal, *Desalination and Water Treatment*, [www. deswater. com](http://www.deswater.com)**



**Summary of research**

- Removal of fluoride is a desalination technology in which fluoride ions from aqueous solution are adsorbed on suitable adsorbent surfaces. This work aim to determine equilibrium sorption of fluoride on surface modified activated nano-alumina in aqueous solution.
- Results indicated that adsorption occurred rapidly in beginning, and equilibrium was reached on surface modified, i.e., grinded activated alumina. At equilibrium, adsorption capacity was about 28 mg g<sup>-1</sup> (i.e., mg of fluoride per g of alumina) in case of activated alumina, whereas it was noted as 39 mg g<sup>-1</sup> for grinded activated alumina for pH of 3.0 and fixed fluoride concentration of 100 mgL<sup>-1</sup> in aqueous solution.
- Furthermore, adsorption isotherms and kinetics was performed in which Freundlich model indicated better fit, indicating heterogeneous nonlinear monolayer sorption among adsorbed particles. Overall, the present research reveals that the grinded activated alumina can be a prospective adsorbent for treatment of fluoride contaminated water.



**Research publication by faculty/scholar with Nano science center of AKU affiliation  
Highlights (Academic Year: 2019-20)**

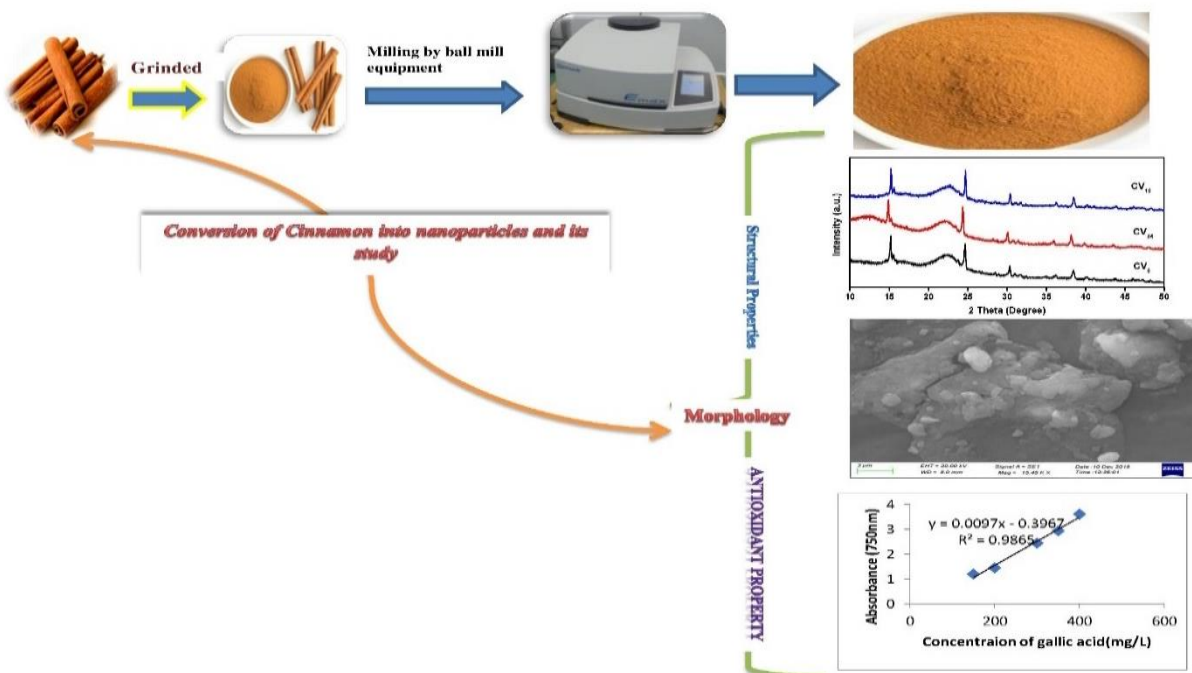
**title of research-** Preparation of superfine grinding Cinnamon Food Nano powder using high energy ball mill and Evaluation of their Structural and Antioxidant Properties for health and Biomedical Applications.

Research team- Archana, Dr. Rakesh Kumar Singh, Dr. Abhay Kr Aman, Nishant kr et al.

Journal details- Emerging Material Research (SCI and Scopus Indexed)



- Superfine Cinnamon food Nano powder of different morphology and crystal structures were successful prepared using high energy ball milled for High industrial and scientific interest. The crystal structure, functional group, were evaluated using modern scientific tools. pressure grinding produces new surface structure, which are beneficial for physicochemical behavior.
- The phenolic content, Hydroxyl radicals and superoxide radicals scavenging activity, antioxidant properties was found to increase as the milling hour and superfine behavior increases. The present research finding opens a new window for progress of surface science of food nano powder for **Biomedical powder engineering, pharmaceutical, health and medicine industries.**



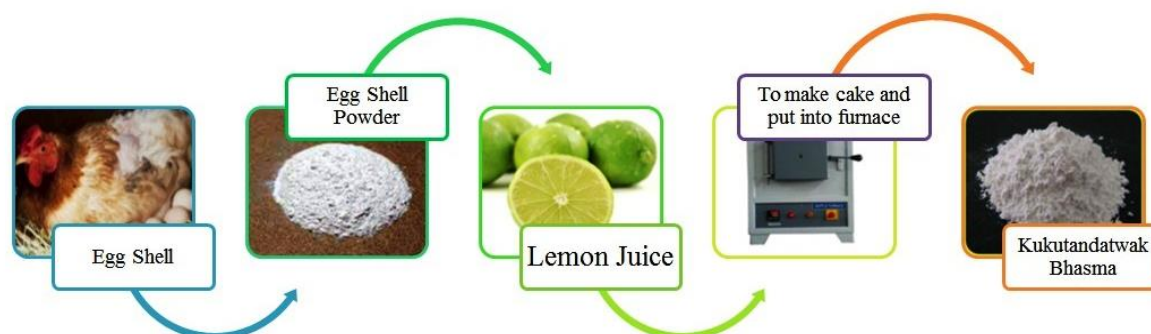
**Graphical abstract for production of Food nano powder for Biomedical Engineering/Health sector**

**Research publication of faculty/scholar with Nano science center of AKU affiliation  
Highlights (Academic Year: 2019-20)**

**Research Paper accepted for publication in Journal Materials Today Proceeding-Elsevier (Scopus indexed)**

**Title of the paper-** Calcium oxide (CaO) Nanomaterial (KukutandatwakBhasma) from Egg shell: Green Synthesis, Physical Properties and Antimicrobial behaviour.

**Research Team-** Sweta Sinha, Abhay Kr. Aman, Rakesh Kr. Singh, Nishant Kr, et al.



- CaO nanomaterials from natural waste egg cell as kukutandatwak bhasma was successfully prepared using the eco-friendly green approach. XRD and Electron microscopy analysis determined its average size below 100 nm.
- **This supports the requirement of multiple calcinations or heat treatment as recommended in classical Ayurveda text proposed by Indian forefather.** Thus, continuous heat treatment imparts specific behaviour that might be responsible for the therapeutic activity as a special class of medicine as a natural substitute.
- The antimicrobial evaluation revealed that Kukutandatwak Bhasma as nanomedicine is more effectual antifungal than antibacterial. The clear zone of inhibition for fungus *BeauveriaBassiana*, *Pacelomyceslilacinus* *TricodermaHarzianum* showed the significant antifungal property of KB Nanoparticles against soil-born fungus. It may be suggested that kukutandatwak Bhasma can be used as a promising antifungal agent in sericulture, mushroom cultivation, in treatment of pathogens and as a hand wash agent as a natural substitute. Green approach of preparing CaO nanomaterials from waste egg shell and their possible applications in health and medicine may open a new window for development of society. Magnetic and luminescence behavior obtained of this CaO nanomaterials from natural egg shell may also be useful as magneto-optical devices and related field.



## Structural, optical, and magnetic properties of non-stoichiometric lithium substituted magnesium ferrite nanoparticles for multifunctional applications

Nishant Kumar<sup>1</sup> · Rakesh Kr Singh<sup>1</sup> · Harendra Kr Satyapal<sup>1</sup>

Received: 2 January 2020 / Accepted: 21 April 2020 / Published online: 13 May 2020  
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Journal details- J. Materials Science and Materials in Electronics (SCI and Scopus indexed)



- In the present research article, structural, optical and magnetic properties along with Curie temperature of lithium substituted magnesium ferrite nanoparticles,  $Mg_{0.5+x}Li_{1-2x}Fe_2O_4$  ( $0 \leq x \leq 0.35$ ) have been reported. Scanning Electron Microscopy are used for grain size determination with surface morphology analysis and found agglomerated nanocrystalline of different size.
- The energy band gap was found 2.5 eV, 1.98 eV and 2.41eV respectively for the three prepared nanomaterials. While enhancement in Photoluminescence spectra measured using Photoluminescence spectrometer (PL) observed with decrease in lithium concentration. The magnetic parameter like saturation magnetization (coercivity and anisotropic constants were found to be increasing with the decrease in lithium ion concentration
- This non-stoichiometric structure was observed to affects the Curie temperature from 479°C to 454°C which opens provides the possibility of **this nanomaterials for broad range of applications in memory devices, isolators, circulator etc.**



Prepared Magnetic Nanomaterials



Highlights

Paper accepted for publication in Materials Today Proceeding-An International Journal, Elsevier (Scopus indexed)

Title of the research -Effect of superfine grinding on Structural, Morphological and Antioxidant properties of Ginger (*Zingiberofficinale*) Nano powder for health and Biomedical applications.

Research group - Archana, Dr. Abhay Kr. Aman, Dr. Rakesh Kr. Singh, Mr. Nishant Kr



- Take Ginger rhizome
- Clean and dry it at room temperature
- Cut into small piece
- Grind the sample using mixture grinder
- Keep it for Ball Milling for 5 and 10 hr. respectively
- The speed should be 500 rpm for both clock and anticlockwise with time interval 30 minute with 2 minute rest
- Milled powder kept in air sealed bag for further use.

- The superfine ginger food nanopowder powder was prepared successfully using high energy ball milling equipment.
- Scanning electron microscopy measurement indicates that pressure grinding for different time duration changes the surface morphology, which can have a considerable impact on the physical-chemical behaviour of prepared ginger powder for various industrial applications.
- Antioxidant behavior depends on superfine properties of ginger powder. A well-researched and thorough analysis through surface science of such natural food materials using advanced technology can lead to the industrial and scientific development of various medicinal uses for mankind.
- Therefore, the present research opens a new window for the progress of surface science of superfine ginger powder for the pharmaceutical, **health, and medicine sector.**

**Research publication by faculty/scholar with Nanoscience center of AKU affiliation -  
Highlights (Academic Year: 2019-20)**

**Paper under review for publication in Journal of Materials Science and  
Engineering: B (SCI Journal)**

**Title of research -Synthesis and Physical properties of amorphous Nano silica from  
Rice husk (agriculture waste) and its composite materials.**

**Research Team- Atul Jyoti, Dr. Rakesh Kr Singh, Nishant Kumar, Dr. Abhay Kr Aman et al.**



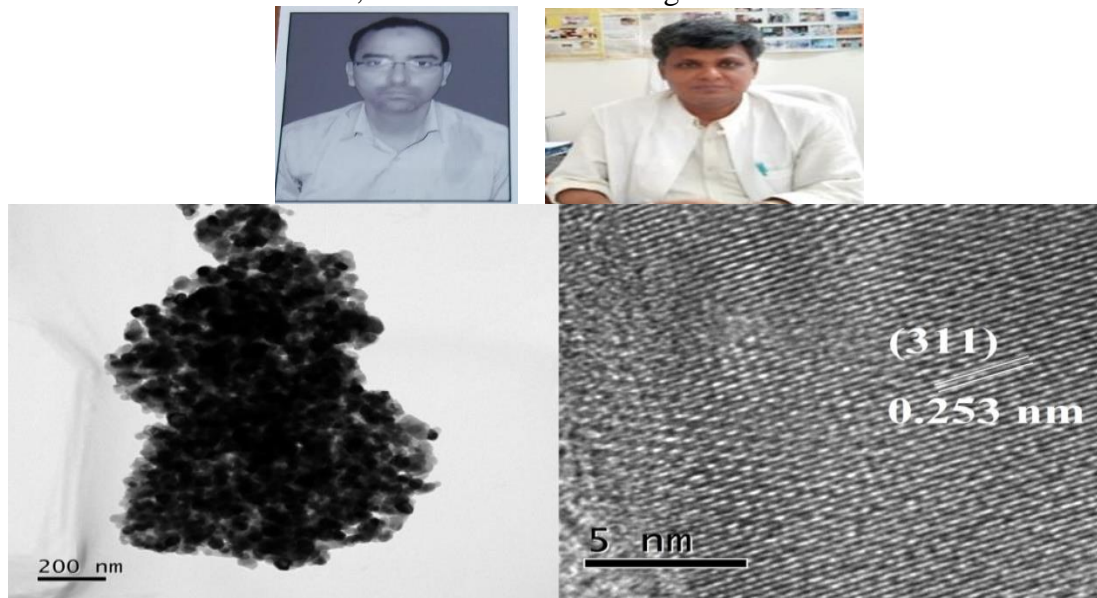
- Small size amorphous nano silica ( $\text{SiO}_2$ ) was prepared by using cost-effective and environment-friendly method. FTIR spectra shows the absorption peaks indicating the existence of Si-O-Si (silanol) functional group. The photoluminescence spectrum reveals the broad excitation of radiation in the visible region.
- The magnetic hysteresis loops of silica-ferrite composite reveal that these materials can be used as polymer magnet
- Polymer could be prepared by using amorphous silica, magnetic ferrite, and PVDF polymer. Nano-silica as an engineering material has numerous applications in various area of science and technology including, Electronics, biomedical science and optoelectronics devices etc. due to its physical characteristics. Hence, Measurement of physical characteristics of nano silica from rice husk (Agriculture waste) and its magnetic polymer composite may suggest scientific communities for various industrial applications.

**Research publication by faculty/scholar with Nanoscience center of AKU affiliation - Highlights**

**Title of research - Effect of doping different rare earth ions on microstructural, optical, and magnetic properties of nickel–cobalt ferrite nanoparticles.**

**Journal- Journal of Materials Science: Materials in Electronics- SCI journal**

**Research team- Kamar Tanbir, Dr. Rakesh Kumar Singh et al.**



- Different rare earth ion-doped nano size Ni–Co spinel ferrites have been synthesized using standard chemical co-precipitation route. The mean crystallite size was found to be in the range of  $15 \pm 4$  nm obtained.
- An excellent size and shape homogeneity among the nanoparticles were also achieved which was confirmed by the HRTEM image.
- The complete paramagnetic behavior of rare earth ions at room temperature resulted in reduction of super exchange interactions, and therefore the Curie temperature was observed to reduce as seen from  $M-T$  plots.
- It is well established that the nano size nickel ferrite particles exhibit soft ferrimagnetic semiconducting nature but this Co-Ni combination exhibited almost 5.1 k Oe coercivity along with moderate saturation magnetization at 60 K even in very small size. **This prepared Ni-Co nano ferrite can be useful for permanent magnet applications at low temperature.**
- The width of the optical energy bands becomes narrower and also results in increase of band gap. **These ferrite nanoparticles can be used to block red and infra-red region of EM spectrum due to their excellent absorption properties over that range.**



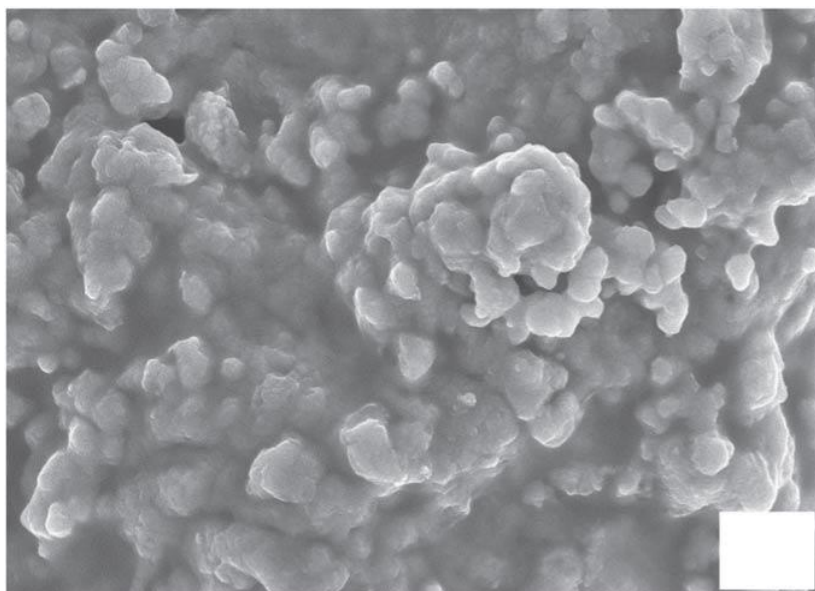
**Sol-gel synthesis, crystalline phase, optical absorption, and photoluminescence behavior of cerium-doped (Ba<sub>0.5</sub>Sr<sub>0.5</sub>)FeO<sub>3-δ</sub> powders**

**Journal detail- Mater. Res. Express (SCI journal)**

**Research team- Dr. Rakesh Kr Singh et al.**



The cerium- and iron-based perovskite type materials have received attention due to their applications in solid oxide fuel cells, sensors, catalysts, and gas separation membranes. An attempt has been made here to synthesize such compounds and characterize them for crystalline phases, photoluminescence and optical absorption properties. They are shown to exhibit phases as perovskite-type cubic as well as orthorhombic in the composition range. Their photoluminescence spectra provide evidence for structural defects including oxygen vacancies. The optical absorption peaks at 620 and 700 nm are attributed to various charge transfer transitions. The characteristics make the prepared materials system technologically viable for oxygen separation from air.



Scanning electron micrograph of prepared nanomaterials

**Research publication by faculty/scholar with Nanoscience center of AKU affiliation**  
**Highlights**

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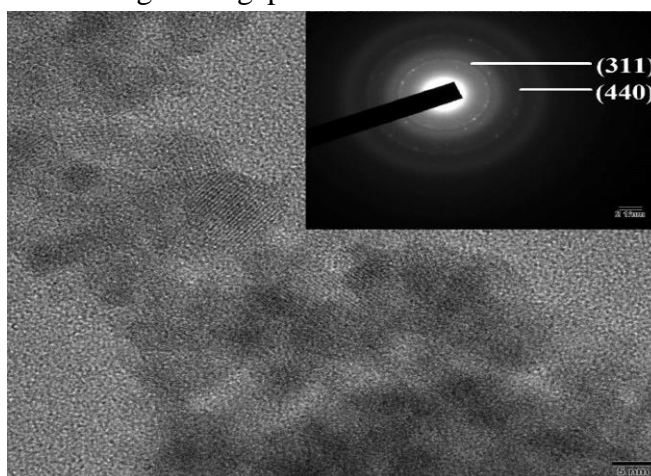
**Research title-** Gd-doped soft Mn–Zn nano ferrites: synthesis, microstructural, magnetic and dielectric characterizations.

**Journal-** Journal of Materials Science: Materials in Electronics (2020) 31:3529–3538.

**Research Team -** Kamar Tanbir, Dr. Rakesh Kumar Singh et al.



- Composition-dependent Gd-doped soft Mn–Zn of range of  $3 \pm 1$  nm spinel ferrites were prepared using chemical co-precipitation method.
- The observed superparamagnetic behavior of all the samples at room temperature is due to the non-magnetic nature of Gd ions and tiny size of the particles. **Such kind of nanoparticles with proper biofriendly coating is suitable for targeted drug delivery and hyperthermia cancer applications.**
- The presence of magnetically dead surface layer and disordered surface spins was reflected by the reduction in saturation magnetization with increasing Gd content at 5 K. The Néel temperature was observed below 50 K for all the prepared samples.
- **The synthesized nanoferrites were excellent absorber near red and infrared region of EM spectrum at room temperature as observed in Tauc plots. These nanoparticles can be suitable candidate to block infrared rays.**
- All the samples exhibited good dielectric behavior at low frequencies. The effective contributions of grain boundaries in overall impedance were verified by the single semi-circle arc in the Nyquist plots. We broadly conclude that the sample with 15% Gd doping has shown the most advantageous properties such as RT superparamagnetism and large bandgap.



High resolution image and SAED pattern (Inset) nano ferrite materials



Contents lists available at ScienceDirect

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## Low temperature synthesis and influence of rare earth Nd<sup>3+</sup> substitution on the structural, magnetic behaviour of M-type barium hexa ferrite nanomaterials

Harendra Kumar Satyapal, Rakesh Kumar Singh \*, Nishant Kumar, Saurabh Sharma

*Aryabhata Centre for Nanoscience and Nanotechnology, School of Engineering and Technology, Aryabhata Knowledge University, Patna 800001, India*



- The Neodymium substituted barium hexaferrite nanomaterials ((BaFe<sub>12</sub>-X NdXO<sub>19</sub>) for (x = 0.0 to 1.0) has been synthesized using low cost citrate precursor-based sol gel method in low temperature range.
- Saturation magnetization values are highest for 0.25 mol doped Barium hexaferrite and of the order of 58.24 emu/g. Whereas maximum coercivity values are found for 0.75 mol Nd doped barium hexaferrite. The maximum coercivity value is (5234.4) Gauss.
- It is observed that magnetization and anisotropy values are maximum for 0.25 mol Nd doped Barium lattice but both these magnetic values decrease for higher concentration of Nd in a similar fashion with minimum values for 1 mol Nd concentration.
- The Curie point is observed to be shifted to a lower temperature value (429 C) from 446 C with Neodymium substitution. The decrease in the Fe<sup>3+</sup> ions may be one reason guided by decrement in exchange interactions between iron ions. **The present study suggests that it favors low energy loss in the prepared material. So, it may be fruitful in high density magnetic recording purpose.**



**Prepared Materials**





FALL MEETING

San Francisco, CA | 9-13 December, 2019

GH23B-1237

# Equilibrium Sorption of Fluoride on the Activated Alumina in Aqueous Solution

Rakesh Kumar<sup>1</sup>, Prabhakar Sharma<sup>1</sup>, Rakesh Kumar Singh<sup>2</sup>

<sup>1</sup>School of Ecology & Environment Studies, Nalanda University, Rajgir, India

<sup>2</sup>Aryabhata Centre for Nanoscience & Nanotechnology, Aryabhata Knowledge University, Patna, India



आर्यभट्ट ज्ञान विश्वविद्यालय  
ARYABHATA KNOWLEDGE UNIVERSITY



Nalanda  
UNIVERSITY

**NATIONAL SCIENCE DAY 2020 (RAJ BHAWAN, PATNA)**  
**CONVERSION OF WASTE INTO WEALTH & KNOWLEDGE**  
**NANO SILICA PRODUCTION FROM RICE HUSK & THEIR APPLICATIONS FOR VARIOUS INDUSTRIES**

**Innovator: Md Muzzammilul Haque Siddiqui**  
**Group Members: Manu Shreshtha, Shubham Kr Choudhary, Ashwani Kant Bose, Rahul Kr Raman,**  
**Mentor: Dr Rakesh Kumar Singh, Academic Head (I/C)**  
**Aryabhata Centre for Nanoscience and Nanotechnology, Aryabhata Knowledge University, Patna**

**GENERAL INTRODUCTIONS**

- ❑ Rice husk is agricultural waste burn in air to form husk. In this process the organic matter decomposes and Silica obtain as major component.
- ❑ During milling of paddy (Rice) about 78% of weight is received as rice and the rest 22% as husk.
- ❑ This husk contains about 75% of organic matters, burning of husk to yield rice husk ash (RHA).
- ❑ This RHA contains 85-90% amorphous silica.
- ❑ The bulk density is around 90 kg/m<sup>3</sup>.
- ❑ Silica naturally exists in the form of nanoparticles. Living plants rice absorbs silica in the form of silicic acid from soil, & silica accumulates around cellulose micro component.
- ❑ Silica is the second most abundant element in the earth's crust.
- ❑ Silica nanomaterials are biocompatible and degrade over time in the body

**OBJECTIVES**

- ❑ Using this low cost chemical based method Nanosilica can be produced from rice husk in large quantity for commercialization.
- ❑ The main reason is that Rice husk is available in abundant as by product in our society. In this innovation prepared useful material are being obtained by research group of Nanotechnology center of AKU from waste material.
- ❑ All the Modern Characterization Techniques such as: XRD, VSM, SEM, AFM & STM, PL, UV-VISIBLE-NIR, FTIR etc. facilities are available at AKU. Thus various properties of nano silica can be obtained using modern scientific tools.
- ❑ Production of Crystalline and Amorphous Nanosilica using low cost method can be obtained for various applications as mentioned.

**SYNTHESIS PROCESS OF NANO SILICA ( BEING CARRIED OUT AT NANOSCIENCE CENTER, AKU UNDER GUIDANCE OF DR. RAKESH KR SINGH)**

**National Science Day-2020 ( Raj Bhavan , Patna)**  
**Aryabhata Knowledge University , Patna**  
**Ferrite Magnetic Nano Materials and their Applications**  
**Innovator: Shashank Bhushan Das**  
**Group Members: Uday Shankar , Singh Sonu Kr. , Om Priya , Gaurav Kr.**  
**Mentor: Dr. Rakesh Kr. Singh, Academic(I/C)**  
**Center for Nanoscience and Nanotechnology, Aryabhata Knowledge University , Patna**

**Summary**  
Ferrites are iron oxide materials have importance in several field of engineering and technology due to its Magnetic property , high resistivity and low eddy current loss. The properties of Ferrite changes drastically at Nanoscale. Nano Ferrite are being used in water purification, Storage devices , Sensors, LED, Medical Science etc.  
Our main objective is to be synthesized of different size of ferrite nanomaterials for applications in several sector as mentioned.  
We will work/collaborate with related company that can commercialize the different nanoscale ferrite particles, prepared by our group. Such activities boost up the entrepreneurship

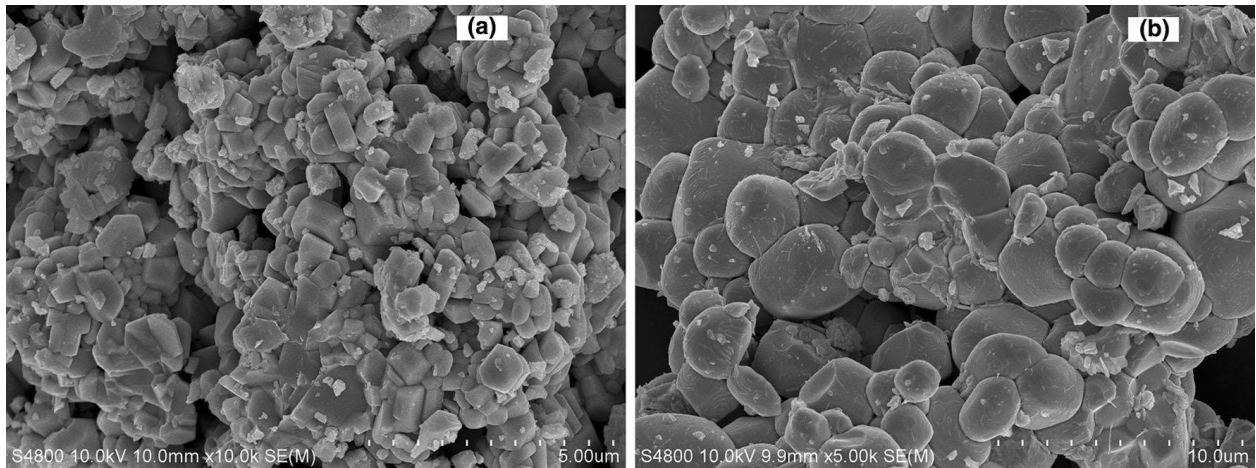
**Ferrite Nano Materials Production at Nanoscience Center , AKU**

**Research publication by faculty/scholar with Nanoscience center of AKU affiliation**  
**Highlights (Academic Year: 2019-20)**

**Research title- Effect of Fe Concentration on Ferroelectric and Magnetic Properties of Lead Iron Niobate**

Journal of ELECTRONIC MATERIALS-Springer

**Research group-** Dr. Rakesh Kr Singh et al.



- Magnetolectric (ME) multiferroics show multiple functional properties due to the coexistence of magnetic and electric ordering parameters and coupling between them. Lead (Pb)-based transition metal oxides with  $ABO_3$  perovskite structure is the promising candidates.
- Lead iron niobite,  $Pb(\text{Fe}_{1/2}\text{Nb}_{1/2})\text{O}_3$  (PFN) belongs to type-I multiferroics, which has received much attention in recent years due to its potential technological applications'-ray diffraction patterns suggest the formation of pyrochlore-free monoclinic symmetry of PFN in  $Pb\text{NbFeO}_3$ .
- Crystallite size is found to be in 24– 29 nm range and decreases with the increase in Fe concentration. Raman analysis shows the existence of both bending and stretching of Fe-Nb-Fe bonds. Magnetic properties enhance with the increase in Fe concentration in the sample. Magnetic coercivity decreases, whereas remnant magnetization increases with the increase in Fe concentration due to the magneto crystalline anisotropy of the sample.