



# पदार्थ

## Newsletter

Volume 1, Issue 1  
October 2021



Department of Physics and Materials Science and Engineering  
Jaypee Institute of Information Technology, Noida, U.P., India

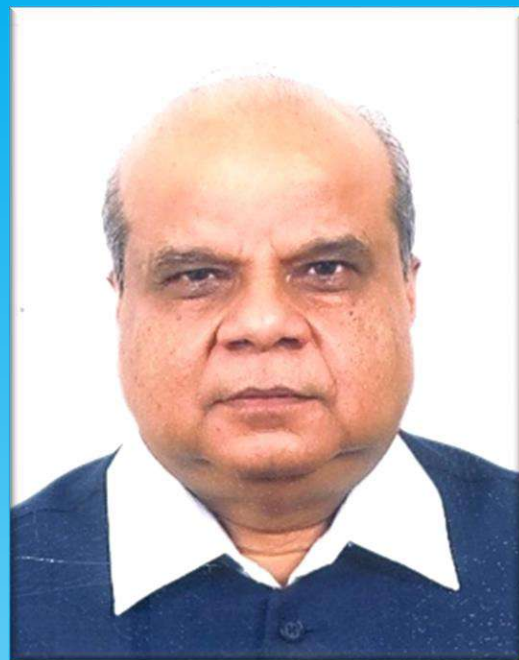
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# Message from the Pro-Chancellor

I am indeed pleased to know that the Department of Physics and Materials Science and Engineering (PMSE) is going to publish the inaugural issue of its departmental newsletter 'Padarth' (पदार्थ). I would like to congratulate the Department for this timely initiative. Such a newsletter is expected to include recent research activities and other achievements of the Department. It will provide a window for displaying different skills and talents in writing articles to students, faculty and staff of the Department. In this difficult time of pandemic, the enthusiastic efforts made by the faculty members and students of the PMSE Department to publish first issue of Padarth is appreciable. This fact is reflected in the newsletter where poets, science communicator, dancers, cartoonists and others have contributed the articles.



I would like to congratulate the editorial team, faculty members, staff, students and alumnus of the Department for their efforts to bring out the newsletter. I hope Padarth will open a new window for the PMSE Department and will become a regular publication in future.

With compliments and best wishes,  
Prof. S. C. Saxena  
Pro-Chancellor  
Jaypee Institute of Information Technology, Noida

# Message from the Vice-Chancellor

Jaypee Institute of Information Technology, Noida was established in the year 2001. Since then JIIT is committed to provide an updated and innovative curriculum and deliver it with sincerity. We have a responsibility to ensure high academic standards and respect for research integrity. JIIT is unconditionally committed and fully dedicated to create the necessary dynamism to comply with rigorous academic studies and professional activities to meet the challenges of the new age of the world.



विद्या वितर्को विज्ञानं स्मृतिः तत्परता क्रिया ।  
यस्यैते षड्गुणास्तस्य नासाध्यमतिवर्तते ॥

*Nothing is impossible in life for those who have knowledge, reasoning, science, memory, readiness, and efficiency.* To impart these vital characteristics to students Department of Physics and Materials Science and Engineering (PMSE) is constantly working on it. I would like to congratulate the Department of PMSE for publishing the inaugural issue of the newsletter 'Padarth'. It gives a platform to students to showcase their multidimensional personality.

I believe that this newsletter will serve the purpose of reflecting all activities of Department and it will inspire others to do their best.

I extend my best wishes to the entire team of editors and contributors of newsletter.

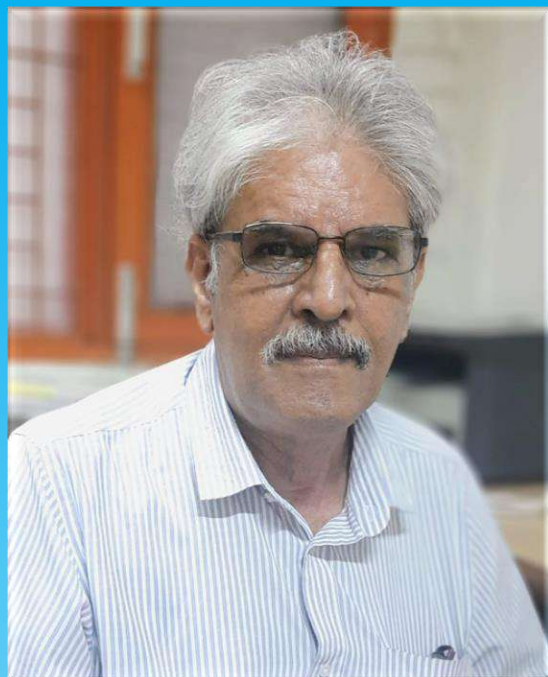
With best wishes  
Prof. Y. R. Sood  
Vice-Chancellor  
Jaypee Institute of Information Technology, Noida

# Message from Head of the Department

“Remember to look up at the stars and not down at your feet. Never give up work. Work gives you meaning and purpose and life is empty without it.

— Stephen Hawking

It is often said “Give me a copy of your Institute magazine, I will tell you about the quality of your Institute”. I strongly believe in this statement as a magazine reflects the ethos and aspirations of the students, faculty and other members of an institution. Generally, the students of science do not show much interest in creative activities, but our department is an exception to this, the students and faculty here are full of creative talent, they show their activity throughout the year. Now we have a platform to document those activities and showcase the talents in the Departmental Newsletter “Padarth”.



Personally, I am extremely happy that the Department of PMSE is bringing out first issue of its Newsletter “Padarth” this year. I went through the articles and poems to be published in this magazine. They amply demonstrate the communication skills, poetic prowess, imagination and creativity, humor and humanism, technical competence, and patriotism of the contributors. It is always a pleasure to be a part of a team which strives to bring out the talents of students and staff. I wish the newsletter a grand success.

With best wishes

Prof. S. C. Katyal

Head of the Department

Department of Physics and Materials Science and Engineering

# Message from Editorial Team

It's exactly two decades since JIIT as well as the Department of Physics started its journey in 2001 when gravitational wave was not detected and material that encircles a black hole was not imaged. Much time has been spent since then and with time the Department's purview has been enhanced and name has been changed to the Department of Physics and Materials Science Engineering, and it has also seen many things to happen for the first time- first externally funded project came around 2006, almost at the same time first set of PhD students joined the Department, first PG program of the Department also started in 2006. First international conference happened in 2011. The journey continued and in 2019 first batch of MSc (Physics) students joined us. They have just graduated, and the journey is still continuing and adding to the above we are going to add another "first"- the Department is going to publish first issue of its Newsletter "Padarth" (पदार्थ). The name reflects the two main facets of the activities of the Department, i.e., "Physics" and "Materials Science". Not only that, it also reflects the love and feeling of all the members of the Department who has sacrificed many things in life to understand the properties of पदार्थ and the secret rules & symmetries of the Nature that leads to those properties.

The idea is to publish two issues of the Newsletter in every academic year. Each issue will report the recent activities of the Department and showcase the achievements of the students, faculty, staff and alumni. It will also provide a window to showcase other skills of the physicists. We all know that Einstein used to play violin and Feynman used to play bongo, but we are often unaware that the colleague working in a serious problem of plasma physics or optics is also a poet or a PhD student busy in solving a problem of field theory also draws nice cartoons in her notebook. The Newsletter will showcase all such hidden skills of the present and past members of the Department. It was not easy to publish the first issue of Padarth, but the enthusiastic response from the faculty members and students and encouragement of the university administration have made the task easy. So, in this big-bang moment of Padarth, we would like to thank everyone involved in this process with a special mention of Dr. B C Joshi who has designed the cover. We hope that universe of Padarth will expand for ever.

Editorial team

Prof. Anirban Pathak

Prof. Papia Chowdhury

Dr. Suneet Kumar Awasthi

Dr. Anuraj Panwar



# Vision and Mission of the Institute and the Department

## JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY

### VISION

To become a centre of excellence in the field of it and related emerging areas of education, training and research comparable to the best in the world for producing professionals who shall be leaders in innovation, entrepreneurship, creativity and management.

### MISSION

**MISSION 1:** To develop as a benchmark university in emerging technologies.

**MISSION 2:** To provide state-of-the-art teaching learning process and R&D environment.

**MISSION 3:** To harness human capital for sustainable competitive edge and social relevance.

## DEPARTMENT OF PHYSICS AND MATERIALS SCIENCE AND ENGINEERING

### VISION

To be a centre of excellence in teaching and research in Physics and Materials Science & Engineering

### MISSION

**MISSION 1:** To offer academic programs and courses in the areas of Physics and Materials Science for nurturing manpower with analytical and independent thinking and scientific temperament.

**MISSION 2:** To conduct fundamental and applied research in emerging areas of Physics and Materials Science.

**MISSION 3:** To foster interaction and collaboration with national and international bodies and institutions for enrichment, application and transfer of knowledge in Physics and Materials Science.

## Journey of the Department Portrayed Through an Interaction with Prof. D. K. Rai

**Prof. D.K. Rai (DKR in what follows), presently Dean (Academic and Research), JIIT is teaching Physics at JIIT since the inception of the Institute. He is the longest serving faculty of the Department and he has observed the Institute and the Department to evolve over last two decades. In the inaugural issue of “Padarth” he shares his experiences and views through an interaction with Dr. Ashish Bhatnagar (AB hereafter), Assistant Professor, PMSE Department, JIIT, Noida.**



**AB:** When did you join the Department of Physics and Materials Science and Engineering (PMSE), Jaypee Institute of Information Technology? What

got you interested in department of PMSE at Jaypee Institute of Information Technology?

**DKR:** I joined the institute in the very year of its inception i.e., in 2001. The vision of the institute, teaching environment, research opportunities and the pace of progress of the institute as per its vision made me interested in Jaypee Institute of Information Technology and serve as a faculty in the department of PMSE.

**AB:** How this Department of Physics and Materials Science and Engineering got established and what are its goals?

**DKR:** Department of Physics was established as an independent department in 2001 only with a goal of excellence in teaching and research as is articulated in its vision statement. Initially, till 2006, department was engaged in teaching and development of various theory courses and laboratories for undergraduate engineering students and research. In the year 2006, the department started M. Tech program in Materials Science and Engineering and enrolled first batch of students in its PhD program in addition to the undergraduate teaching. Experimental labs for M. Tech and PhD students were established. Department also got its very first research project in 2006 from DST. The name of the department was also changed from Department of Physics to Department of PMSE in this very year.

**AB:** How was the feeling when the Department received first research project, first PG program, first PhD student or organized first ever international/national conference, so many firsts have happened in front of you.



**DKR:** Academic departments of a university should have their PG and PhD programs and all faculty members should be engaged in research and other academic activities alongside teaching. Therefore, it was quite satisfying to start PG and Ph.D. programs, holding conference, submitting/acquiring the project, procuring research equipment, and starting research activity in the department all for the first time. Department of PMSE has been fortunate to have faculty members with high academic credentials. These could be possible only with the collective effort of all.

**AB:** How do you compare the Department of Physics of 2001 to the PMSE Department of the present time, i.e., in 2021?

**DKR:** I can see the enormous growth of the department as compared to what it was in 2001; however, scope of doing better always exists. In 2001, we had only two faculty members and few courses for B. Tech students. However, in the current time, there are 22 faculty members in the department with excellent profile and varied teaching and research specialization. Department offers more than 20 core and elective courses suitable for B Tech students, runs M. Sc program in Physics and PhD program in PMSE. Around 20-22 PhD scholars, on the average, work in the department both in theory and experiment. Every year department publishes on an average 35 publications in journal of international repute. Faculty members have successfully completed various research projects granted by Government agencies. They have various funded and non-funded research collaborations with national and international universities/research labs.

**AB:** Today education has come up with technical courses and they seem to stay, but for students who are still opting for traditional domains like pure sciences (physics), what does their future look like in the next 5-10 years?

**DKR:** All the technological advancements have become possible only because of advancement in sciences. Modern technology can move forward only with the growth of sciences. The future for pure sciences particularly physics is bright particularly when boundaries between science and engineering are narrowing down with time. Be it electronics and communication engineering, information storage and security, communication technology, optical technology, energy harvesting, to name a few, science and engineering move hand in hand. Moreover, Physics, in particular, is a subject which offers opportunity to human being to satisfy their natural curiosity to understand nature. Therefore, this subject will never have dearth of brilliant people not only from technology side but also from various other domains.

**AB:** How the research and teaching work going on in the Department of Physics and Materials Science and Engineering align to the mission of India as a self-sustained nation?

**DKR:** The research and teaching being carried out in the department of PMSE is well aligned with the mission of India as a self-sustained nation. Some of the key areas of national interest

currently are energy, quantum cryptography, nanotechnology, etc., in which department carries out research which evidenced from high quality publications.

**AB:** What do you think should be the areas where the Department should focus?

**DKR:** Department has a strong academic manpower resource and hence has great potential for further growth. Department should aspire for patents, new research labs, more collaborations, more grants in the department in future.

**AB:** How the research and teaching work going on in the Department of Physics and Materials Science and Engineering align to the mission of India as a self-sustained nation?

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# Upcoming Events

## 1. International Conference on Energy and Advanced materials.



The banner for ICEAM-2021 features a background image of a modern university campus with orange-leaved trees. The text "ICEAM-2021" is prominently displayed in large, white, 3D letters. Below the banner is a central logo for the conference, which is a hexagon divided into six colored segments, each representing a different material science or energy topic: Advanced 2D materials, Optical, Electrical & Magnetic materials, Hydrogen Energy, Porous & Biomaterials, Technology for energy, and Advanced energy materials. The logo also includes the text "ICEAM 2021" and "HYDROGEN". On either side of the central logo is the Jaypee Institute of Information Technology (JIIT) logo, which consists of a stylized torch and the text "JAIPEE INSTITUTE OF INFORMATION TECHNOLOGY" and "jiit" with the motto "विद्या तत्त्व ज्योतिषमः" below it.

Registration: <https://iceam.co.in/registration/> Conference Home: <https://iceam.co.in/>

**International Conference on  
Energy & Advanced Materials**  
**21-23 October, 2021**  
**Organized by**  
Department of Physics and Materials Science & Engineering  
Jaypee Institute of Information Technology, Noida, India

## 2. One week Faculty Development Program 2022.

## 3. JIIT OSA Student Chapter Conference 2022.

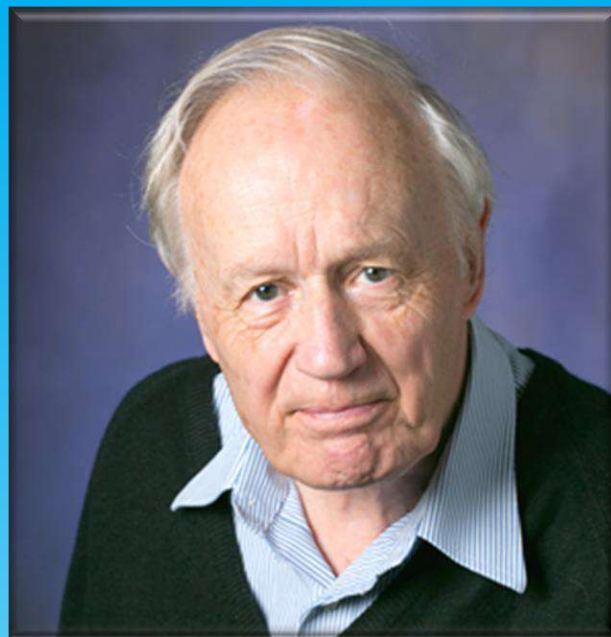


# Events Organized in 2021

## Nobel Laureate's Lecture

At present Prof. Sir Anthony J. Leggett, is John D. and Catherine T. MacArthur Professor and Center for Advanced Study Professor of Physics, at the University of Illinois Urbana-Champaign. He is a world leader in the theory of low-temperature physics, and his pioneering contributions to the "theory of superconductors and superfluids" was recognized by the **2003 Nobel Prize in Physics**.

In 2005, he was Knighted, i.e., received Order of the British Empire (KBE) "for services to physics" by Queen Elizabeth II. He is Fellow of Royal Society and various Academies and Societies of importance, including National Academy of



Sciences, American Physical Society, Institute of Physics, Russian academy of science, etc. Apart from Nobel prize, he is also recipient of various other prestigious awards like Simon memorial prize, Paul Dirac medal and Prize, Maxwell medal, etc. He has very broad research interest, which includes but not restricted to super fluidity, superconductivity, foundational aspects of quantum mechanics, quantum information, etc.,

Prof. Leggett delivered the talk on 06 Jan. 2021. He talked about "Bell's theorem, entanglement, quantum teleportation and all that". One of the most surprising aspects of quantum mechanics is that under certain circumstances it does not allow individual physical systems, eve when isolated, to possess properties in their own right. This feature, first clearly appreciated by John Bell in 1964, has in the last three decades been tested experimentally and found (in most people's opinion) to be spectacularly confirmed. More recently it has been realized that it permits various operations which are classically impossible, such as "teleportation" and secure-in-principle cryptography. Nobel laureate lecture was attended by more than 200 participants.

**Invited Talk:** Dr. Indranil Chakrabarty is an Associate Professor at International Institute of Information Technology Hyderabad. He works in the area of Quantum Information Theory, Quantum Foundation, Quantum Cryptography, Quantum Communication and Network. Dr. Indranil Chakrabarty presented the basic and extensive review of broadcasting of quantum correlations on 03<sup>rd</sup> Jan 2021. In quantum information theory, entanglement and other measures of correlation plays a significant role in the computational and communicational processes like quantum key distribution, secret sharing, teleportation super dense coding and in many other

tasks. At least in that context, purer the entanglement more valuable is the given two qubit state. Therefore, extraction and distillation of pure quantum entanglement from partially entangled states is considered to be an important task. The possibility of compression of quantum correlations naturally raises the question if the opposite, i.e decompression of quantum correlation is possible or not. Many researchers actually answered the query by using the process called “Broadcasting of Inseparability”. The question becomes important when there is exigency in increasing the number of available entangled pairs rather than purity of it. Invited talk was attended by 65 participants.



**Invited Talk:** Prof. Arindam Ghosh is the group leader of Quantum Materials and Devices Group at the Department of Physics, Indian Institute of Science Bangalore. He is Infosys Prize Awardee of the year 2020. Earlier, in 2012, he received S. S. Bhatnagar Award and he is internationally known for his outstanding contribution in the field of materials science and condensed matter physics. He has been recognized for his work on developing atomically thin 2D semiconductors for next-generation electronics, and for creating a new platform for light-matter interaction that “impacts quantum technologies and sensing in a fundamental way.” He is also playing a crucial role in forming the structure of the National Mission on Quantum Technologies and Applications.

Prof. Arindam Ghosh delivered an invited talk on “Emerging Materials for Quantum Technology” on 21<sup>st</sup> April 2021, 3:00 P.M. He covered wide range of topics such as, structural, electrical and magnetic properties of various nanoscale systems, in a wide variety of materials. His research stressed more on fundamental quantum mechanical effects on charge and spin states in nanosystems, to carbon-based electronics, critical behavior in smart materials, to new schemes of sensing with nano/micro-electromechanical sensors. Invited talk was attended by 65 participants.



## JIIT Student Conference on Optics and Photonics-2021

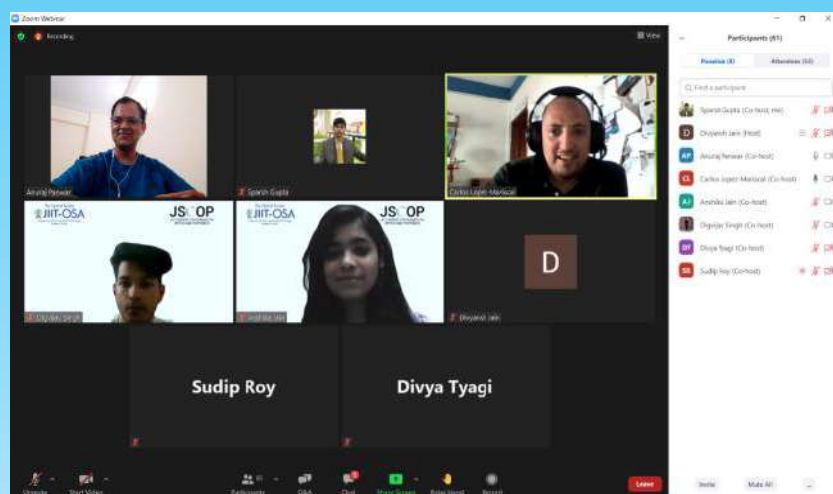
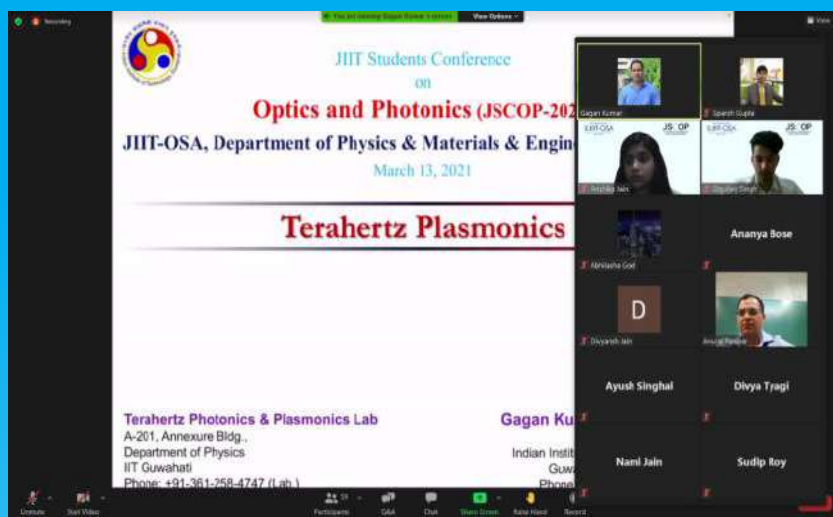
JIIT Student Conference on Optics and Photonics-2021 (JSCOP-2021) was graced by various eminent professors and scholars from all over the country, along with a footfall of more than 160 attendees in two days comprising undergraduates, postgraduates, PhD scholars and faculty members. On 13<sup>th</sup> March JSCOP-2021 started its official inauguration in the presence of Prof. S. C. Katyal, Head of the Department of Physics and Materials Science and Engineering, PMSE faculties, JIIT Noida and Dr. Gagan Kumar, Associate Professor, Department of Physics, IIT Guwahati, PMSE faculties and a resplendent welcome to all the esteemed guests by JIIT OSA President, Divyansh Jain followed by the greeting from JIIT OSA Faculty Advisor, Dr. Anuraj Panwar. Two days event consisted of 4 sessions including 6 talks by eminent speakers with Codeathon (Hackathon competition), brain box (quiz competition) and one poster competition. On 13<sup>th</sup> March firstly Dr. Gagan Kumar presented terahertz technology having the potential to develop the next generation ultra-high-speed communication devices and highly sensitive sensors. Dr. Rakesh Kumar Singh, Associate Professor, IIT BHU explained about “Developing Quantitate Imaging Microscope with Chaotic Light”. How chaotic light could be used for Quatitate Imaging Microscope analysis. In session 2 a science quiz competition aka Brain Box was organized by members of JIIT-OSA Student Chapter. In evening time Dr. Carlos L. Mariscal, Appalachain State University Boone, USA talked on “Tailoring custom polarization states”. He explained tailoring custom polarization states for the application of underwater photonics. After that aka Codeathon, a coding-based competition, was organized by Coding Ninjas on their own online platform at [codingninjas.com](https://codingninjas.com).





On 14th March 2021 Prof. V. Sekkar Cochin University of Science and Technology, Kochi & Former Scientist, VSSC, ISRO on “Propellant systems being adopted for ISRO launch vehicle programs”. He explained the brief history of Indian Space Programmes (Insights in Vikram Sarabhai’s life, first rocket launch). After that Dr. Rhythm Singh, Assistant Professor, Department of Hydro and Renewable Energy, IIT Roorkee talked on “PV Potential Estimation”.

Dr. Singh imparting the knowledge about Renewable Energy Sources, Green energy, and Solar Power and explained PV potential estimation. Dr. Vidhu S. Tiwari, Visiting Faculty, IIIT-Sonipat & DCRUST, Haryana. Dr. Tiwari discussed “Laser Raman Spectroscopy based Optical Fiber Sensors” by Laser Raman Spectroscopy based Optical Fiber Sensors. parameter. After that Codeathon Solution Webinar was held to discuss the questions and their possible answers of the Codeathon competition, which was held prior to the day of webinar. On the same day, the poster presentation competition aka Iridescence was organized by members of IIIT-OSA Student Chapter and was held online on Google Meet. At last a Valedictory function was organized to announce the prizes and trophies to the winners. Dr Anuraj Panwar, Faculty Advisor IIIT-OSA Student Chapter, gave the vote of thanks to all speakers, guests and eminent scholars for making this conference successful.



# Recent Publications



1. Kapoor, V., Sharma, Navneet K., Gupta, S., Kumar, P., "Fiber optic SPR sensing of liquids using copper and zinc oxide", Optik, vol. 238, pp. 166727, 2021.
2. Singh S., Goswami, N., Structural, magnetic and dielectric study of Fe<sub>2</sub>O<sub>3</sub> nanoparticles obtained through exploding wire technique, Current Applied Physics 22, 20-29, 2021.
3. Bhandari P., Malik V., Kumar D., Schechter M., ' Relaxation Dynamics of the three-dimensional Coulomb glass model'. Physical Review E, vol 103, pp 032150, 2021
4. P. Malpani, K. Thapliyal and A. Pathak, " Can we control the amount of useful nonclassicality in a photon added hypergeometric state?", J. Opt., vol.23, 025202, 2021.
5. A. Saxena, A. Shukla and A. Pathak, " A hybrid scheme for prime factorization and its experimental implementation using IBM quantum processor", Quant. Infor. Process., vol. 20, 112, 2021.
6. M. Das, K. Thapliyal, B. Sen, J. Perina and A. Pathak, "Interplay between quantum Zeno and anti-Zeno effects in a non-degenerate hyper-Raman nonlinear optical coupler", Phys. Rev. A, vol. 103, 013713, 2021.
7. Pooja, P. Chowdhury, "Functionalized CdTe fluorescence nanosensor for the sensitive detection of water borne environmentally hazardous metal ions", Optical Materials, Vol. 111 pp. 110584, 2021.
8. M. Rana, C. Banerjee, P. Chowdhury, "Studies on optical signal due to oxygen effect on hydrogenated amorphous/crystalline silicon thin films", Applied Physics A, vol. 127, pp. 192, 2021.
9. V. Shukla, A. Bhatnagar , S. K Verma , A. Pandey , A. Vishwakarma , P. Srivastava , T. P Yadav and O. N. Srivastav, "Simultaneous improvement of kinetics and thermodynamics based on SrF<sub>2</sub> and SrF<sub>2</sub>@Gr additives on hydrogen sorption in MgH<sub>2</sub>", Materials Advances, vol. 2, pp. 4270-4290, 2021.
10. M Smitha, Y. Sheena Mary, Y. Shyma Mary, Goncagül Serdaroglu, Papia Chowdhury, Meenakshi Rana, H. Umamahesvari, B.K. Sarojini, B.J. Mohan, Rani Pavithran, "Modeling the DFT structural and reactivity studies of a pyrimidine -6-carboxylate derivative with reference to its wavefunction-dependent, MD simulations and evaluation for potential antimicrobial activity" Journal of Molecular Structure, vol. 1237, 130397, 2021.
11. S. Chauhan, M. Kumar, A. Yousuf, P. Rath, M. Sahni and S. Singh, "Effect of Na/Co co-substituted on structural, magnetic, optical and photocatalytic properties of BiFeO<sub>3</sub> nanoparticles" Materials Chemistry and Physics, vol. 263, 124402, 2021.

- 12.** M. Sisodia, K. Thapliyal and A. Pathak, "Optical designs for realization of a set of schemes for quantum cryptography" *Optical and Quantum Electronics* 53, 206 (2021).
- 13.** Shreya Sahai, Anshu Varshney, "Solar absorbance enhancement in perovskite solar cells with the inclusion of copper nanoparticles: an architectural study" *Opt Quant Electron* 53, 111 (2021).
- 14.** Kapoor, V., Sharma, Navneet K., "Preparation and characterization of a silver-magnesium fluoride bi-layers based fiber optic surface plasmon resonance sensor", *Instrumentation Science & Technology*, vol. 49, pp. 395-403, 2021.
- 15.** Ashish Bhatnagar, Anant Prakash Pandey, M Sterlin Leo Hudson, Pawan K Soni, Satish K Verma, Vivek Shukla, V Sekkar, Manoj Tripathi, ON Srivastava. "Economical synthesis of highly efficient and tunable carbon aerogels for enhanced storage of CO<sub>2</sub> emitted from energy sources", *International Journal of Energy Research*, vol. 45, pp. 6285-6292, 2021.
- 16.** Manoj Tripathi, Ashish Bhatnagar, Krishna Kumar Pandey, Poo Balan Ganesan, " Synthesis, Characterization and Performance Study of Biomass Derived Supercapacitor Electrode", *Journal of The Electrochemical Society*, vol. 168 pp. 050530, 2021.
- 17.** S. S. Pundir, Kuldeep Mishra, and D. K. Rai, "Structural, thermal and electrochemical studies of PVA/PVP—NH<sub>4</sub>SCN—[C<sub>2</sub>C<sub>1</sub>Im][SCN] polymer electrolyte system" *J Mater Sci: Mater Electron*, 32: 1476-1490, 2021.
- 18.** Harshlata, Kuldeep Mishra, D.K. Rai, "Studies on ionic liquid based nanocomposite gel polymer electrolyte and its application in sodium battery", *Materials Science & Engineering B*, Volume 267, 115098, 2021.
- 19.** D. Tripathi, Ashish Bhatnagar, Shalini Raj, D.K. Rai and T.K. Dey, "Levitation force of Graphene added bulk MgB<sub>2</sub> superconductor", *Cryogenics*, Volume 118, 103343, 2021.
- 20.** Sakshi Gandhi, Suneet Kumar Awasthi and Arafa H. Aly, "Biophotonic sensor design using a 1D defective annular photonic crystal for the detection of creatinine concentration in blood serum", *RSC Adv.*, 11, 26655-26665, 2021.



# Science beyond classroom

## JIIT OSA Student Chapter (<https://jiitosachapter.in/>)

JIIT OSA (Optical Society of America) student chapter, Department of Physics and Materials Science and Engineering, Jaypee Institute of Information Technology, Noida, is a scientific society aspiring to bring about a change and inspire students by the means of STEM. From organizing industry visits and providing opportunities to round the year workshops and conferences in different domains from software development to photonic research the chapter is an amalgamation of the spirit of innovation and technology.



JIIT OSA student chapter started in 2017 at Department of Physics and Materials Science and Engineering, Jaypee Institute of Information Technology, Noida-62. It is fully run by the students under the supervision of faculty advisors. The chapter conducts election every year for the posts of President, Vice President, Secretary, Treasurer along with some supporting teams like, Strategic, Technical, Outreach, Content and Public relations. Only second year students hold these positions and others participate actively to accomplish each event organized by JIIT OSA student chapter. Glimpses of the event organized by OSA student chapter is in the right.



## JIIT-ACS International Student Chapter

Recently an ACS (American Chemical Society) International Student Chapter is established at the PMSE Department. This chapter is expected to be of use to our students as ACS is committed to helping all members around the world to connect with each other to advance chemistry as a science and a profession. As materials science is one of the thrust areas of the PMSE Department, activities of the Department are closely related to that of ACS. Keeping that in mind, we have established International Chemistry Science Chapters (ICSCs) which would help to connect a member with the other members in the same geographic region. It may be noted that as of today, ACS has 23 ICSCs, and 290 International Student Chapters, 1000 National Student Chapter in USA. Some of the benefits of joining ACS chapters are:

- Qualify for **chapter** awards.
- Present posters at **ACS** meetings.
- Get grants to attend **ACS** meetings.
- Get grant for community service projects.
- Gain opportunities to plan meeting activities and symposia (Grant up to \$700).
- Qualify for exclusive **ACS** contests





# Faculty Corner

## Faculty achievements

Dr. Ashish Bhatnagar, Assistant Professor, PMSE Department has received the prestigious Platinum Jubilee Young Scientist-2020 award of the National Academy of Sciences, India (NASI). This award which is popularly known as the NASI young scientist award is a major award in Indian science.

Dr. Bhatnagar completed his B.Sc. and M.Sc. (Physics) from University of Delhi. Afterwards he joined the Department of Physics, Banaras Hindu University as a PhD student and continued as a post-doctoral fellow. He was the visiting scientist in the University of Pittsburgh, USA in 2014-2015. Earlier, he was awarded with Indo-US Young Entrepreneur, Award, by PSG Institute, Coimbatore and Sunny Polytechnic Institute Alabama (USA) 2016. He is the editorial board member of International Journal of Hydrogen Energy, Elsevier. He works in the domain of energy storage which is extremely relevant for the society.





## भारत

सृजन करें हम ऐसा भारत  
कण कण जिसका राम हो।  
हिन्दुत्व जहां का मूल मंत्र हो।  
गीता जिसका प्राण हो।  
बालक जिसके भगत शिवा हों।  
बाला जिसकी सीता हों।  
ऐसा भारत बने विश्व में।  
जिसने सबको जीता हो।

द्वारा

डॉ० सुनीत कुमार अवस्थी।

**डर तो लगता है,,**

लाख हौसलों की बात करूँ लेकिन  
खुद को खांसी आने पे ,,यूँ ही किसी के छींक जाने पे  
अब डर तो लगता है,,

दोस्तों से हाथ मिलाने में ,, किसी के घर जाने में  
ऑफिस में मिल के गॉशिप करने में,, खुशी या गम में शामिल होने में,,  
अपने ही बच्चे को गले लगाने में,, वाइफ या हस्बैंड के पास जाने में ,,  
अब डर तो लगता है,,

कार/बस/ट्रेन से कही भी जाने में,, लिफ्ट के बटन दबाने में,,  
भीड़ में किसी से भी छू जाने में,, शॉपिंग को बाजार जाने में,,  
कोई भी सामान उठाने में,, दूकान वाले को पैसे देने या लेने में,,  
डर तो लगता है,,

दूर भी कहीं एम्बुलेंस की आवाज सुनने में ,, बीमारी में भी डॉक्टर के पास जाने में,,  
केमिस्ट से दवाई लेने में,, परिचित का हाल चाल पूछने में,,  
डर तो लगता है,,

लाख हौसलों की बात करूँ लेकिन  
खुद को खांसी आने पे ,, यूँ ही किसी के छींक जाने पे है  
अब डर तो लगता है,,

द्वारा

**डॉ प्रशांत चौहान**

# Hydrogen as a Green Fuel

Energy demand and usage are now becoming a rising concern for humankind than any other issue, owing to the improved living standards of people in developing countries. Unlike other requirements, energy is required for survival itself and is required in increasing amounts as the expectations of life i.e. living standards rises. As for example, we need increasing amounts of electricity (produced presently by using the fossil fuel coal) which is used for a variety of purposes which are essential but also for purposes which improve the quality of life e.g. in I.T. (computers, smart mobile phones, and several other IT devices). We want to increase mobility to increase efficiency, which is done by using fossil fuel oil/petroleum for transportation. The energy consumption will apparently be increasing particularly for a country like ours. However, because of the depletion of petroleum, climate change, urban air pollution, and energy security, a new fuel system, which will circumvent all the above shortcomings of petroleum, needs to be developed at a quick pace. One important aspect, which is often forgotten, is that energy requirements and transitions modes to new energy systems are drastically different for different countries. Speaking for India, we have rather large deposits of coal ( $\sim 92,445$  million tons). Therefore, coal is our main fuel for producing electricity. However, the use of coal produces  $\text{CO}_2$  which is the key contributor to climate change. Because of the Paris agreement and December 2015 (signed by  $\sim 200$  countries), we will have to cut down the use of coal to meet the  $2^\circ\text{C}$  cap by 2050. We have already committed to reducing  $\text{CO}_2$  emission by 35% till 2030 by switching to sustainable fuel.

The following issues motivate us to switch over to sustainable fuel.

- Climate change
- Gap between demand and supply of fossil fuel
- Economic burden (Large import of oil 150 MT)
- Urban air pollution

Under these circumstances, we have to fall back more dominantly and perhaps solely on energy derived from renewable and carbon-neutral fuel. Many years of researches asserted that out of the different sustainable energies, hydrogen as a fuel is extraordinary compared to other alternatives. Hydrogen can be produced from water by electrolysis in a clean process. The use of hydrogen among all the present renewable energy resources will be most effective for meeting our demands because hydrogen is inexhaustible, indigenous, 100% clean, and the most abundant fuel in nature. Both cold combustion of hydrogen (in a fuel cell) and hot combustion (in an IC engine) processes lead to the production of water, i.e. hydrogen produced through water and burns back into the water. India has huge water resources such as the Indian Ocean, Arabian Sea, and Bay of Bengal. Therefore, switching to a hydrogen economy is easy for our country. Also the energy per unit mass of hydrogen ( $142 \text{ MJ kg}^{-1}$ ) is nearly three times higher than conventionally used fuel



gasoline (petrol: 46.40 MJ kg<sup>-1</sup>). It thus solves the quadruple problems of the gap in demand and supply of fossil fuel, climate change, and economic burden.

In the late eighties, Jules Verne (science fiction author) set out a judicious vision that has motivated governments and business visionaries in a long time since. In his book The Mysterious Island, Verne wrote “water will one day be employed as fuel, that hydrogen, and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of the intensity of which coal is not capable”.

Even in our Veda also there is full-fledged mention for the Hydrogen Energy as –

अनेन जलभंगोस्ति प्राणोदानेषु वायुषु।  
एवम् शतानाम् कुंभानाम् संयोगः कार्यकृत्स्मृतः ॥

वायु बंधक वस्त्रेण निबद्धो यंमस्तके ।  
उदानः स्वलघुत्वे बिभर्त्याकाश यानकम् ॥

This will lead to disintegration of water into Praan vayu (oxygen) and Udaan vayu (Hydrogen). A chain of one hundred jars is said to give a very active and effective force. The Udaan Vaayu thus created can then be trapped into an air-tight cloth with some tactic. If this is achieved, owing to self-buoyancy of Udaan vayu, it is possible to build a structure capable of flying in air". The above indicates that Hydrogen, produced from water is capable of use as green fuel. In spite of these advantageous and well-known properties of hydrogen as green fuel, we still lag behind in the use of “hydrogen as a wonder fuel”. It is because of technical challenges in the area of its Production, Storage and Application. Out of these, one of the most important criteria is hydrogen storage. As mentioned above and is very well known that hydrogen is the lightest element (very low density - 0.08988 g/L) in the Universe. At normal atmospheric pressure, the weight of hydrogen gas of 1 liter is only 90 mg, which means hydrogen is 11 times lighter than the breathing air. The 1 kg of hydrogen (required to drive a vehicle for 100 km) needs to store in around 11 m<sup>3</sup> volumes. That is why it is necessary to increase the density of hydrogen in order to have packing in lesser volume. This can be done by the following techniques:

- High-pressure storage in the gaseous form
- Very low-temperature storage in the liquid form
- Hydride-based storage in the solid form

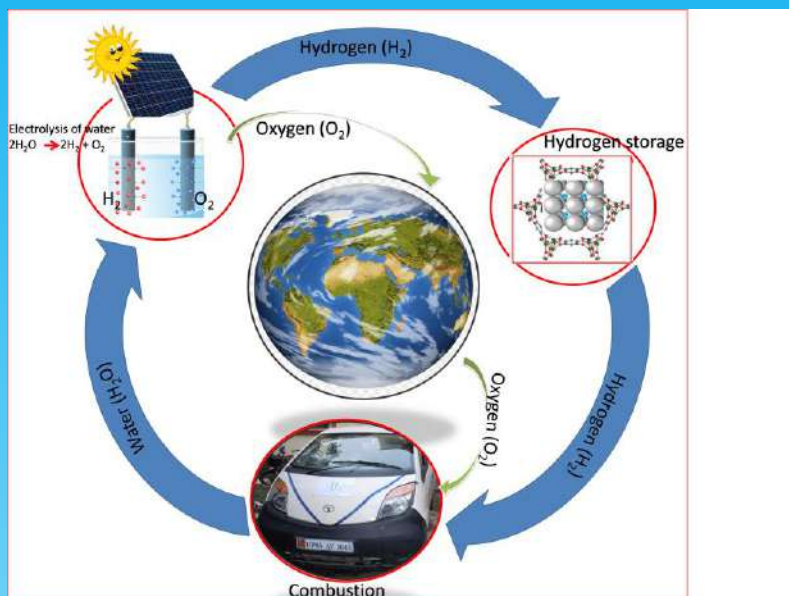
The simplest way to store hydrogen is in gaseous form in a high-pressure cylinder. However, due to the very low density of hydrogen, we require very high pressure (like 300 atm or more). This is very risky and cost-intensive. On the other hand, in the case of vehicular application, about four times more hydrogen pressure is required. However, this much pressure has not been sustained by the commercially available cylinders. Therefore, industries set up a goal to manufacture cylinders that become capable of vehicular applications. These cylinders are much costly and dangerous.

The storage of hydrogen in liquid mode is very expensive. Hydrogen needs a very low critical temperature ( $\sim 33.2$  K) for liquefaction which is very difficult to maintain and above which liquid state cannot exist. Liquefaction of hydrogen leads to two major challenges, which are as follows; (i) the efficiency of the liquefaction process and (ii) boil-off losses. Theoretical works have suggested that the energy need to liquefy the hydrogen gas at ambient temperature is 3.23 kWh/kg, while the technical work reports about 15.2 kWh/kg. Liquid hydrogen inside the cryogenic cylinder ( $\sim 21.2$  K) losses itself due to formation of ortho- to para-hydrogen. This conversion of hydrogen provides a heat source for the gasification of liquid hydrogen. So, the storage of liquid hydrogen is very difficult and can only store in an open system or in a closed system with high pressure of 1000 MPa at ambient temperature.

Amongst various storage modes (like solid-state, gaseous and liquid storage mode), solid-state storage modes as metal/intermetallic hydrides/in porous materials are amongst the widely studies and best-suited mode of storage. Hydrogen storage in solids start back in the 1970s in the Philips Research labs where it was coincidentally found that hydrogen could be reversibly taken up by intermetallics as a hydride. Solid-state storage mode in materials like metal/ intermetallic hydrides, porous materials has high volumetric and gravimetric hydrogen storage capacity as compared to other storage options such as high-pressure and liquid hydrogen storage. The solid-state storage of hydrogen is safe as hydrogen is locked inside in the form of atoms or molecules and will come out only after applying a certain temperature and pressure.

Hence, solid-state storage is a viable, efficient and safe mode and safe mode of hydrogen storage. Here hydrogen is stored in a material through two well-known processes namely (i) physisorption and (ii) chemisorption. Amongst the various solid-state materials metal hydride ( $\text{MgH}_2$ ,  $\text{NaAlH}_4$ ), porous carbon, graphene, and metal-organic framework (MOF) is the front-running candidate for practical application.

The US Department of Energy has floated a target for material for a viable hydrogen storage material for use in vehicular application. These targets are storage capacity of 4.5 wt% (gravimetric) and 30 kg- $\text{H}_2$ /L (volumetric) with 1500 life cycles operation at the temperature range of  $\sim 85$ - $100^\circ\text{C}$ . Research is being carried out worldwide in order to have solid-state hydrogen storage materials, which could meet the above-mentioned target so that we can realize the hydrogen economy more effectively.



**Dr. Ashish Bhatnagar**



## MY FIRST MEMORY OF STARS

Its vague to be honest,  
Like a teeny, tiny dot in the sky.  
Stars never really spoke to me,  
But yes they were the starting point from where i can partake.  
It pushed me towards the lurking darkness.  
It made me ponder over the mysteries of the unseen.  
It made me realize we are more than ourselves,  
More than what we see.  
Our capabilities are endless.

Though,  
They do take us back, in the past.  
Obsolete when the matter around us celebrated its origin.  
They do remind us we are just a speck in the endless streams of stars.  
They make us feel small,  
invisible I should say.

On those dark nights,  
when power cuts were imminent,  
I remember lying under the stars and counting them.  
After a while,  
I didn't lose the number.  
No of stars tends to zero.  
Clouds always obscure my way in confirming the infinite stars.  
Funny right?  
But it was fun.  
Oblivious to the present,  
It surely took me back.  
Letting me stay there,  
Enjoying the past.  
Enjoying the present.  
Both at same time

by  
**Anshul Singhal**  
(MSc, 2021)



## When Dirac met Bose at Calcutta



Drawing  
by

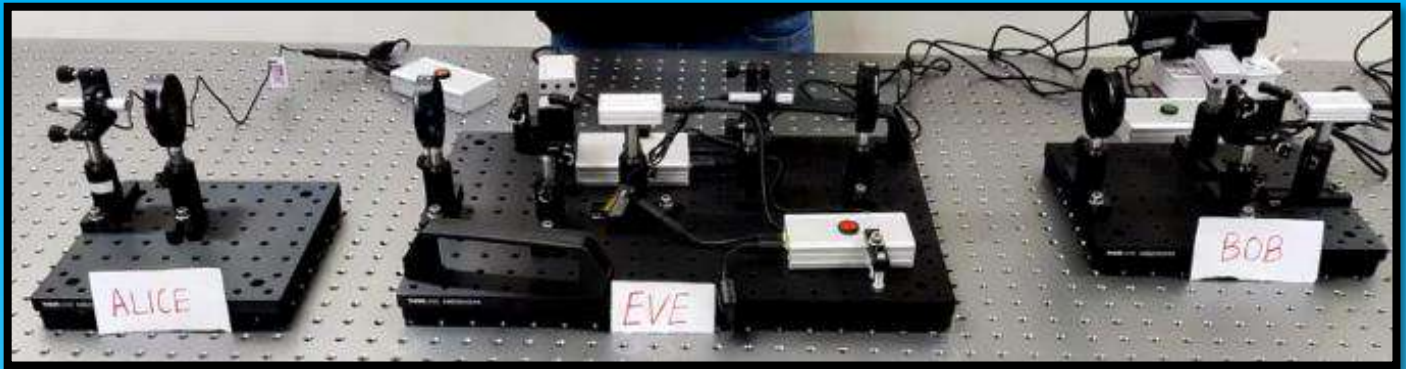
Kathakali Mandal, PhD student

(This is based on a real story and the concept of the cartoon was provided by  
Prof. Anirban Pathak)



Teachers' day celebration organized by PMSE PhD students

## Recently Added Experimental Facilities

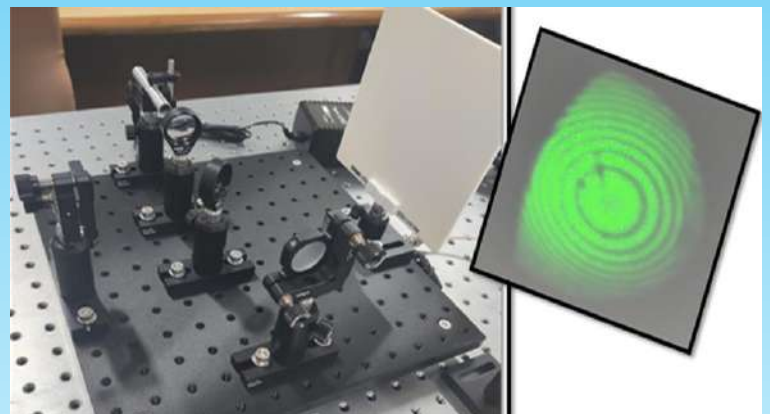


Quantum Cryptography Analogy kit placed on the vibration-less optical bench.

With the support of various DST and DRDO projects, a new experimental facility is developing at the PMSE Department. Already, off-the-shelf quantum random number generator, various laser sources, optics, vibration-less optical bench, and kits like, Quantum Cryptography Analogy Demonstration kit and Bomb Testing kit are procured. Proof of principle experiments are also done to show BB84, B92 and SARG protocols, and Elitzur-Vaidman bomb testing scheme. Also randomness tests are recently performed on the outputs of the quantum random number generator (QUANTIS) which has recently been added to the list of available equipment in the lab.



Quantum random number generator



Elitzur-Vaidman Bomb Testing kit.



# Fourier Transform Infrared (FTIR) Spectrometer

Recently, the department has upgraded a research equipment named Fourier Transform Infrared (FTIR) spectrometer. FTIR Analysis or FTIR spectroscopy is an analytical technique used to identify organic, polymer, and, in some cases, inorganic materials. This machine is used widely by researchers from the PMSE Department and other Departments of JIIT, as well as researchers working outside JIIT. The Department already had FTIR spectrometer, to keep the lab at the state-of-art condition, Institute has recently supported the procurement of a new FTIR machine which has following specifications:

**Name of the machine:** FTIR Spectrometer

**Model:** Spectrum Two

**Make:** PerkinElmer

**Specifications:** 21 CFR Part 11 (APV/AVI configuration), Single Reflection Diamond U-ATR mode (L1600107); Detector Type LiTaO<sub>3</sub> MIR Operating Range 5 - 45°C Wave Length Range 8,300 – 350 cm<sup>-1</sup> (KBr window) with resolution of 0.5 cm<sup>-1</sup>.





## In-house fabricated Liquid nitrogen cooled R-T measurement facility

A liquid nitrogen cooled R-T measurement setup is successfully fabricated at the Department of PMSE. Existing Keithley 2400 source meter is used to provide a constant current ( $\sim 20\text{mA}$ ) to the sample and corresponding voltage signal is scanned with the help of Keithley 2182A nano voltmeter. The temperature of the specimen is monitored and controlled with the help of in-house developed temperature controller with an accuracy of  $0.1^\circ\text{C}$ . This setup is capable to measure the temperature dependence of resistivity using four probe DC measurement techniques in the temperature range 100K to 400K with an uncertainty of  $\pm 3\%$ .



# Alumni Corner

The popular e-magazine named “The Quantum Daily” has recently published a list of 52 Wonder Women Working in Industry as Quantum Scientists & Engineers, where Dr. Anindita Banerjee is featured in the 39th position. Dr. Anindita Banerjee is an illustrious alumnus of the PMSE Department. Almost a decade ago (in 2010-11 academic year) she completed her Ph.D. under the supervision of Prof. Anirban Pathak. After completing Ph.D. she worked as an Assistant Professor in Women Engineering College, Durgapur, and subsequently as a Research Associate and CSIR Pool Officer at the Bose Institute, Kolkata. Later she moved to industry and at present, she is working as a quantum research head and VP at QuNu Lab, Bengaluru which is India’s 1st company for quantum technology. At QuNu Lab she has played a pivotal role in developing India’s first commercial solution for quantum key distribution and quantum random number generator. In addition, apart from a large number of research papers, she has also co-authored a book published by SPIE.

For the inaugural issue of the Padarth, Ms. Kathakali Mandal (KM hereafter), a Ph.D. student of the PMSE Department has interviewed Dr. Banerjee (AB hereafter) on different aspects of her professional life and research. Here is an extract of the same.



**KM:** To begin with, can you tell us a bit about your activities after completing Ph.D. from IIIT.

**AB:** After completing Ph.D. from IIIT, I had started my journey as Assist. Prof. in Women Engineering College, Durgapur. However, I was always inclined to pursue research in quantum technology. Fortunately, I got this opportunity at Bose Institute as Research Associate, where I continued this journey for 5 and a half years. I was asked to take lead in

important activities at Quantum Optics Lab at Bose Institute from the middle of 2012. We started performing single-photon experiments and this was first in India. Thereafter, I joined QuNu Labs a startup incubated by IITM Research Park. It was a journey of 3- 4 years and eventually, we developed, marketed and sold India’s first Quantum Key Distribution system and Quantum Random Number Generator. Now, I am looking forward to a new journey.

**KM: I understand that it was a great journey and appreciate your role in building India's first commercial solution for quantum cryptography. However, I would like to know whether your transition from academia to industry was smooth?**

**AB:** It had been challenging for me and hence it gave me an opportunity to evolve. But now I don't really think about it much.

**KM: Do you have any suggestion for our Department which can make our students more acceptable to the industry?**

**AB:** Students should begin with an internship in the industry. This would provide them an opportunity to understand the technology from different perspectives and allow them to take the initiatives to mold their research in an appropriate manner. Collaboration with industry will also be of great help to them. Department may encourage such internships and collaborations.

**KM: In the last 15 years, you have worked in many organizations and with many people. How is the research atmosphere in India? Do you want any change in that? Or anything you really appreciate.**

**AB:** In India, we already have stalwarts and great teachers from different domains of quantum science. There have been initiatives by Government and private engineering colleges, autonomous bodies, research organizations to introduce Quantum Information related Courses and Quantum Labs. The government and critical organizations are taking appropriate steps to build the quantum ecosystem in India. This is really appreciable.

**KM: You were one of the first two PhD students of the Department. Were not you afraid to join a department that has not produced any PhD till then?**

**AB:** After my Masters in Electronics I was certain to leave studies and take up a career as Kathak Dancer. But after 1 year of teaching Kathak at Amity and part-time work as a national TV anchor, everything lost its charm. I became determined to continue my education, particularly in Physics. I was looking for a teacher who could motivate me and guide me properly in any area of Physics. That was all I was thinking. I wholeheartedly thank Prof. Anirban Pathak, my Ph.D. advisor and I know it will never be enough.

**KM: How was the experience to work in a Department which was really young at that time?**

**AB:** There was more opportunity to learn and take initiatives. The environment was like a family.

**KM: I have heard that when you joined PhD, you were a young mother. How difficult was it to keep a balance between parenting and research?**

**AB:** If want multiple things in life, you need to be ready to perform extra. There is nothing called a balance in reality. Nobody is perfect so let's go easy and try not to be a superwoman.

**KM: Not only in research, usually in all workplaces, the number of women is very less. Did/do you face any difficulty as a woman?**



**AB:** There is a problem in the outlooks towards women and this throws different types of challenges at us from the social and professional front, be it any industry or academia. There is a general lack of awareness regarding the workplace provisions and rights under law, especially for women.



**KM:** Still lots of women unwillingly quit jobs after becoming a mother. What is your advice to them? What is your advice to the female PhD students of the Department?

**AB:** My advice to women is to enjoy life and take care of health, rest will fall in place. If you want to quit and come back, many women have done so and there are many government schemes as well to facilitate you. If you want to continue work with challenging conditions then do so and you will be the best person to find how to manage and perform at both places.

**KM:** We know that you are a good dancer, too. How important it is to have a hobby and how difficult is it to pursue that along with professional life?

**AB:** Very important to keep a hobby. It gives you mental strength and support. My mother told me that she introduced me to dancing and singing to keep it as a friend for life and for inner happiness. Today I feel so grateful to her for this gift.

**KM:** What are the scope and possibilities in the field of quantum technology?

**AB:** Immense. It's the best time to explore and build your career in this technology.

**KM:** What advice you want to give to the student, who want to do research on quantum technologies.

**AB:** Take internships in quantum startups, quantum labs or get involved in quantum projects. India and the world would need multidisciplinary workforce hence there is a huge opportunity.

**KM:** Where do you get motivations for perusing Research?

**AB:** I think research is a creative subject so I enjoy it.

Link of the e-magazine: <https://bit.ly/3m9ZSy6> and <https://bit.ly/3F4ayXH>

# JIIT PMSE Alumni Meet 2021

The first JIIT PMSE alumni meet was conducted in online mode on 25th July 2021. The meet was attended by more than 60 PMSE alumni. Inauguration of the meet was conducted with gracious presence of honorable Pro Chancellor JIIT Noida, Prof. S. C. Saxena and Vice Chancellor JIIT Noida, Prof. Y. R. Sood, Dean Academic and Research Prof. D. K. Rai and Former HOD PMSE Prof. K. C. Mathur. They addressed the alumni with motivating words and extended very warm, cordial and affectionate welcome to all the Alumni. Former HOD PMSE Prof. K. C. Mathur shared his memory and blessed all alumni and department members. Many PMSE alumni presented their research achievements and shared their memories and felt happy to attend the first JIIT PMSE alumni meet.







**Department Of Physics And Materials Science And Engineering**  
**Jaypee Institute Of Information Technology, Noida**  
**1st "PMSE Alumni Meet-2021" (virtual mode)**

**Dr. Chitra Shukla**  
 Assistant Professor  
**Centre for Quantum Computing (CQC)**  
**Peng Cheng Laboratory (PCL), Shenzhen, 518000, P. R. China**

Date: July 25, 2021 (Sunday)  
 Time: 6:00 pm - 8:00 pm  
 Google Meet Link: <https://meet.google.com/ghm-tmev-qsn>














### 10 Years of Research Journey



- 1. Ph.D. (2011-2015)**  
Jaypee Institute of Information Technology (JIT), Noida, India (Prof. Anirban Pathak)
- 2. JSPS Postdoctoral Research Fellow (2015-2017)**  
Nagoya University, Japan (Prof. Masanao Ozawa)
- 3. Postdoctoral Research Fellow (2017-2019)**  
Department of Physics, Tsinghua University, Beijing, China (Prof. Gu-Lu Long)
- 4. Assistant Professor (Assistant Research Scientist) (April 2019-Present)**  
Centre for Quantum Computing (CQC) Peng Cheng Laboratory, Shenzhen, China













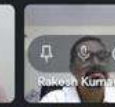



















































meet.google.com/ghm-tmev-qsn?authuser=2
REC

6:45 PM | PMSE Alumni Meet



34°C AQI 73
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25-07-2021





## Leading Woman Researcher Award

Dr. Meenakshi Rana, JIIT PMSE alumni working in Uttarakhand Open University as Academic Consultant has received the Leading Woman Researcher Award from Uttarakhand State Council for Science and Technology on 8th March, 2021.

