

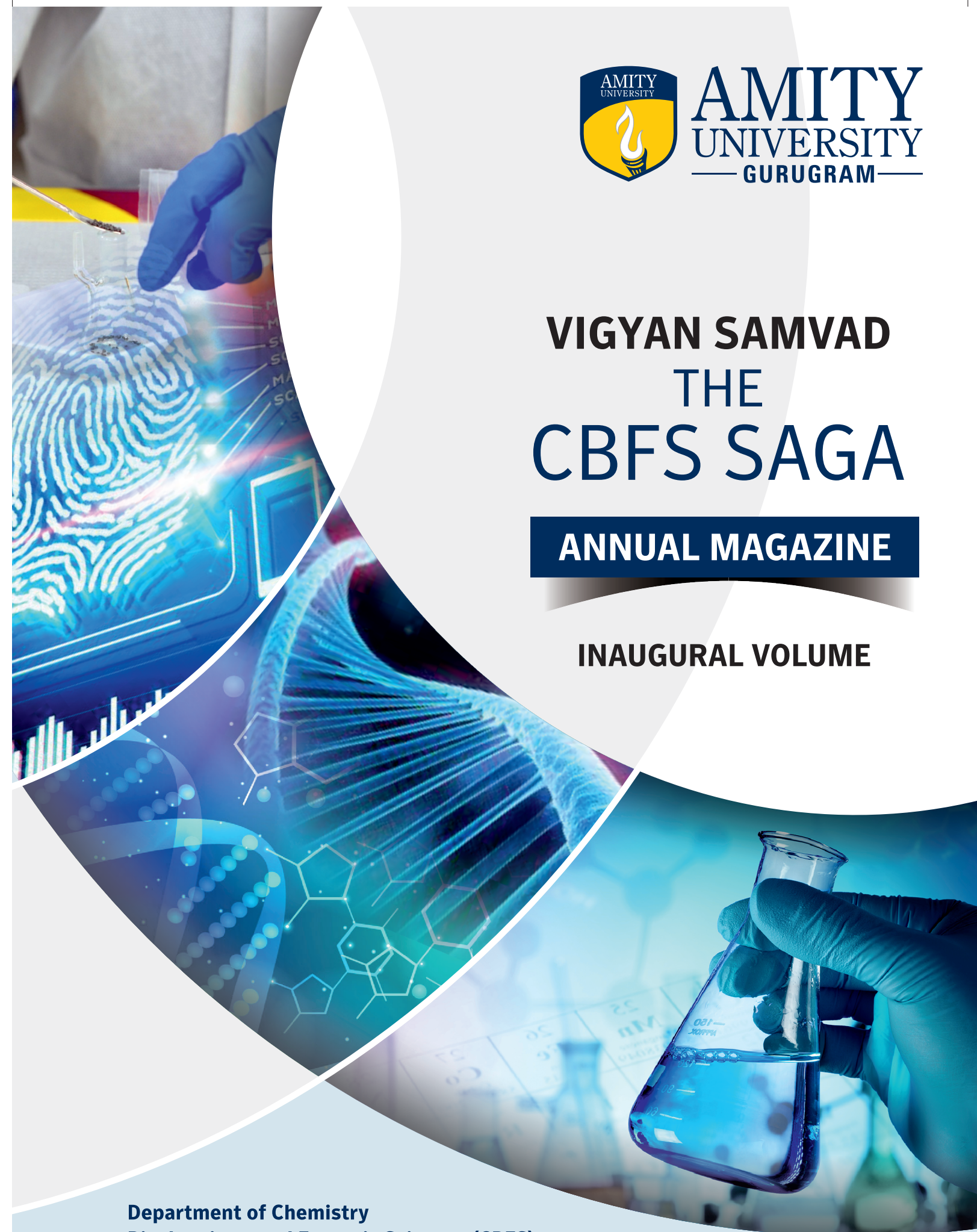


**AMITY**  
UNIVERSITY  
— GURUGRAM —

# **VIGYAN SAMVAD THE CBFS SAGA**

**ANNUAL MAGAZINE**

**INAUGURAL VOLUME**



Department of Chemistry  
Biochemistry and Forensic Sciences (CBFS)  
Amity School of Applied Sciences  
Amity University Haryana  
Tel: 0124-2337015/16

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## MESSAGE FROM PROF. P. B. SHARMA, VICE CHANCELLOR, AUH



It gives me immense pleasure to note that the Department of Chemistry, Biochemistry, Forensic Science, ASAS of the Amity University Haryana is bringing out the “Vigyan Samwad-The CBFS Saga” in the form of a magazine to widely disseminate the academic, research and innovation activities, academia-industrial collaborations along with programmes being pursued by department at our prestigious University. I am also happy to note that the magazine is depicting the latest research developments in diverse areas.

I am of the opinion that the universities worldwide are judged on their contributions to knowledge creation, technology development, innovation and industry readiness of their graduates. Sponsored R&D forms a major pillar of strength of a university and so is its quest for innovative, interdisciplinary and translational research. I am indeed happy to note that here at AUH we are engaged in research oriented UG and PG programs along with Ph.D doing R&D in areas of vital interest to industry and society. I invite the innovative and creative faculty and inspired students to celebrate the success made so far and engage themselves with relentless curiosity in accelerating the pace of industry and society relevant research and innovations. I wish the publication a great success.

## MESSAGE FROM PROF. P. BANERJEE, PRO-VICE CHANCELLOR, AUH



Department of Chemistry, Biochemistry & Forensic Science, ASAS is a unique platform to inculcate and promote research acumen among students and faculty members. The Department, with its expertise in Chemistry, Biochemistry & Forensic Sciences, is committed to world class teaching and developing interdisciplinary research through its research and PhD programs. The department is a holistic mix of highly energetic, inventive and knowledgeable faculties along with greatly inspired students, all of them aspiring to explore new realms in the area of science.

The Department aspires to indoctrinate a structured learning through intellectual interaction between the students and faculty, through its especially designed UG & PG programmes in CBFS, which uses world class technology and state of the art infrastructure at AUH.

I wish all the esteemed faculty members of the Chemistry, Biochemistry and Forensic Science department all-round success and the very best in all their endeavours.

**MESSAGE FROM****PROF. A.K. YADAV, HEAD OF INSTITUTION, ASAS, AUH**

Department of Chemistry, Biochemistry & Forensic Science, a part of ASAS, started its journey in the year 2012. The department has a distinguished record in both teaching and research. Faculty members have excellent academic credentials and are highly respected in their respective research domains. They have received many prestigious awards and recognitions at national and international levels.

In CBFS, there is a strong research orientation in UG and PG programs in areas of vital interest to industry and society. The department has a strong PhD program contributing significantly to the research output. This issue is enriched by scholarly articles contributed by the faculty. The main objective of publishing this magazine is to popularize some of the marvellous feats in chemistry, biochemistry and forensic sciences so as to excite readers from diverse backgrounds.

I wish the Head of Department good luck for launching the department's magazine Vigyan Samwad-The CBFS saga.

**MESSAGE FROM****PROF. S. R. PATHAK, HOD, DEPARTMENT OF CBFS, ASAS, AUH**

Welcome to the Department of Chemistry, Biochemistry and Forensic Science, ASAS at Amity University Haryana. Our graduates work in almost every technology-based industry: dyes, drugs, chemicals, petro-chemicals, pulp, paper and textiles etc. Our goal for undergraduate, postgraduate and PhD students is to give them a high-quality education that includes hands-on experience and an excellent research culture. Each of our faculty members are working with enthusiasm in their research specialty with our very bright students on individual projects. CBFS also has strong alumni network. Our alumni are well placed in educational as well as in industrial fields. We provide numerous opportunities to our students to participate in various academic and non-academic forums at AUH. We also encourage our students to participate in various academic and extracurricular activities outside AUH on national and international platforms.

This issue has very interesting articles which we are sure will attract many readers. The issue covers article like Photocatalysis, Waste water treatment, Calixarene, Metal oxides, Polymer composites, Forensic genetics, Botanical weapons and many more. We will eagerly wait for your valuable comments, suggestions and feedback on the articles.

We take this opportunity to thank our contributors for excellent contributions.



## MESSAGE FROM THE EDITOR'S DESK

Department of Chemistry, Biochemistry and Forensic science has successfully chartered a glorious journey of over six years at AUH. The department ensures proper implementation of research projects and mobilization of extra mural funds, along with high quality research publications, review articles and book chapters. The department has also been able to fulfil its mission by motivating students for research innovations. The research output is regularly exhibited at the University level in the form of Posters, Models and Working projects. Most heartening development was that our faculty could compete for major research grants funded by the Government Bodies such as Department of Biotechnology, Department of Science and Technology etc. The department of CBFS has also been able to motivate graduate and post graduate students to opt for a research career. As a result, increasing number of students are now opting for long term internships in our research laboratories. Our students not only have been able to compete for internships in various national and international educational institutes but also got better placements in leading organisation. There is a great effort in maintaining continuous industrial connect and employability of our graduates. The progress in our research innovation drive has also yielded quality publications in high impact journals and books. To show case the excellence in sciences globally, department had regular visits of distinguished guest speakers and organised various national and international meetings in ASAS, AUH. Our students and faculty were also invited to several national and international meetings where they presented their research, chaired sessions and fetched awards. Departments has been able to promote and manage research and innovation drive of AUH, however, there is more to be achieved. We hope that our efforts will bring in more extra-mural grants and laurels in terms of quality publications and patents.

Editors

## INVITED ARTICLE



*Contributed by:*

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### Study of protein folding and dynamics using combined biophysical methods and molecular dynamics simulation

Protein folding mechanisms have been extensively studied in the past few decades through both experimental and computational means. Better understanding of folding requires an accurate description of the transition state, in particular for single domain and two-state proteins. Molecular dynamics (MD) simulations of protein unfolding at high temperature, harsh pH and denaturants with explicit water molecules have been widely used to characterize the same. MD simulations of atomic models of proteins with an implicit representation of the solvent can be used to answer several questions related to the protein folding process.

Recent advances, however, made combined experimental and computational studies of protein folding possible through the development of proteins that fold on the microsecond and even sub-microsecond timescale, and through advances in MD simulations allowing simulation of multiple microsecond folding trajectories. An excellent agreement was observed between results from biophysical and MD simulation studies.

We have analyzed the folding dynamics of proteins associated with the human health using combined biophysical methods and MD simulation. Our ongoing simulations on protein folding will attempt to directly link all-atom folding simulations with folding kinetics data. Through simulations of a variety of protein with different folding rates, we hope to gain a general understanding of factors driving protein folding.

## INVITED ARTICLE



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### From A Chemical Reaction to Media Reaction: A Protein Driven Journey

Proteins are the most enigmatic biological molecules, whose unique chemistry can dictate life, survival and fame. Hemoglobin is a classical paradigm protein, which has helped the understanding of structure-function relationship in proteins and their relation to pathology in addition to their indispensable role in sustaining life. “Hemoglobin” immediately recalls the image of a red heme containing protein associated with oxygen transport and storage in humans and other mammals. The concept has undergone serious changes over the last two decades and the discovery of new globins has expanded the scope of hemoglobin research by leaps and bounds. For one, hemoglobins are now known to be ubiquitous and found across all forms of life. We had identified hemoglobins in diverse species such as *Leishmania major*, *Chlamydomonas reinhardtii* and *Galdieria sulfuraria*. Strikingly, the micro-organism *C. reinhardtii*, a green alga, was found to have 12 hemoglobins, some of which had multiple globin domains while others were hybrid proteins consisting of other domains in addition to globin domains. We have unraveled striking structural features in some other hemoglobins like plant hemoglobins from *Arabidopsis thaliana*, which contains a tunnel connecting heme pockets or display 2-on-2 alpha helical globin fold. We have discovered the unique ability of novel hemoglobin, called neuroglobin, which can form amyloids at neutral pH and in their holo form unlike any other globins. The amyloids thus formed were found to be cytotoxic and had the ability to form channels in synthetic membrane bi-layer raising speculation about their role in neurodegeneration. We also unraveled that the unique chemistry between heme and an amino acid side chain from the protein impart extraordinary stability to bacterial hemoglobin, named *Synechocystis* hemoglobin. This chemistry was mimicked in myoglobin to successfully engineer unprecedented stability in the prototype hemoglobin. This protein engineering success has led the path to its application in creating stable hemoglobin based artificial blood substitute (oxygen carrier) to mimic the functions of human blood to help “blood transfusion” during medical emergencies. The unprecedented chemical reaction also elicited novel media reaction paving the path to glory through protein chemistry.

## INVITED ARTICLE



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### Proteins in a Crowded World: Insights and Challenges

Most experiments on the structure and functions of proteins are performed in dilute buffer media. However, the interior of a cell is highly congested by several different macromolecules, with the concentrations ranging from 50 – 400 g/L. Several studies have revealed that protein structure and dynamics can be appreciably modulated under such conditions of cellular crowding. Macromolecular crowding results in 'The Excluded Volume' effect, wherein, the species involved are considered as hard spheres, that is impenetrable. Under such circumstances, with regards to the protein folding-unfolding scenario, the equilibrium is generally considered to be shifted to that of the native state of the protein, since the more expanded unfolded state experiences a reduced conformational space and hence is entropically unfavorable.

In addition to this, processes as fundamental as enzymatic activity, protein-protein association, protein aggregation and diffusion, to name a few, have all been shown to be influenced by macromolecular crowding.

Our research is focused on some aspects of the crowded scenario along with the efforts made in our group to unravel the intricacies of the same, primarily from the point of view of the local structure of proteins.



## ARTICLES FROM THE DEPARTMENT

### Sequence of Strokes and its Determination

M. Mann and S. R. Pathak

Forensic science is the application of various sciences to the law. The application of allied sciences and analytical techniques to questions concerning documents is termed forensic document examination. The examination of questioned documents consists of the analysis and comparison of questioned handwriting, hand printing, typewriting, commercial printing, photocopies, papers, inks, and other documentary evidence with known material in order to establish the authenticity of the contested material as well as the detection of alterations.

Sequence of strokes is the sequence in which writing strokes are made on the paper. Determining sequence of strokes is an integral part of forensic document examination. For the forensic document examiner it is very important to analyze whether the document as wills, letters, cheques, etc. are genuine or not by examining the sequence of strokes. The need for the investigation of sequence of strokes of writing emerges when it is alleged that a statement is written after the signature was done on the document or this examination can be performed to learn which of the two handwriting was last written. The examination of sequence determination is very important job to fix the accountability of the person who had forged the document by making additions after the accomplishment of the document. There are many cases in which the signatory claims that the document he signed may be disputed as the paragraph or sentence written just above his signature was not present when he signed it. The dispute could be settled if we could determine the sequence of writings when they are intersecting (whether the paragraph was written first or the signature). By examining properties of ink like absorption of ink onto the paper, color of the ink, properties of ink like gloss and luminescence can help in more easier and faster detection of sequence of intersecting lines. The ink distribution onto the paper can mislead the document examiner while detection of sequence of strokes because there are some common misconception like every ink evenly distribute on the paper and forms a compact layer at point of intersection, this can fool the document examiner during analysis or while analyzing and can result in wrong interpretation.

For the analysis of evidence basically two types of techniques are used - destructive and non-destructive techniques. Destructive techniques are those techniques for which the evidence is destroyed during the examination process and non-Destructive techniques are those techniques in which the credibility of evidence is maintained in the examination process i.e. no harm is caused to evidence. So, in Forensic Sciences Non-Destructives are preferred over the destructive ones. For the determination of the sequence of strokes both destructive and non-destructive techniques are present.

## ARTICLES FROM THE DEPARTMENT

### A Man Who Understood the Importance of Industry-Academia Integration 100 years Ago

S. Majumder

Acharya Sir Prafulla Chandra Ray was an Indian chemist, educationist, historian, industrialist and philanthropist. A leading nationalist of his time, he was the founder of the first Indian research school in chemistry and is regarded as the father of chemical science in India. Royal Society of Chemistry honoured his life and work with the first ever Chemical Landmark Plaque outside Europe. Besides his all scientific achievements this great visionary was the founder of Bengal Chemicals & Pharmaceuticals, India's first ever pharmaceutical company. He is the author of A History of Hindu Chemistry from the Earliest Times to the Middle of Sixteenth Century (1902)- a monumental work which described the systematic evolution of scientific progress in chemistry in ancient India.

His thesis title was "Conjugated Sulphates of the Copper-magnesium Group: A Study of Isomorphous Mixtures and Molecular Combinations". While a student he was elected as the Vice-President of the University of Edinburgh Chemical Society in 1888. Prafulla Chandra returned to India in 1888 and subsequently joined Presidency College, Calcutta as temporary Assistant Professor of Chemistry in 1889. Ray who had a doctorate in science from the University of Edinburgh felt deeply aggrieved when even with his excellent educational credentials he was not able to secure a position within the Imperial service and attributed this to the discriminatory attitude of the ruling government towards native Indians. In 1896, he published a paper on preparation of a new stable chemical compound: mercurous nitrite. This work made way for a large number of investigative papers on nitrites and hyponitrites of different metals, and on nitrites of ammonia and organic amines. He started a new Indian School of Chemistry in 1924. Ray was president of the 1920 session of the Indian Science Congress.

### Forensic Intelligence & Aspects of Drug Counterfeiting

R. Rathi and S. R. Pathak

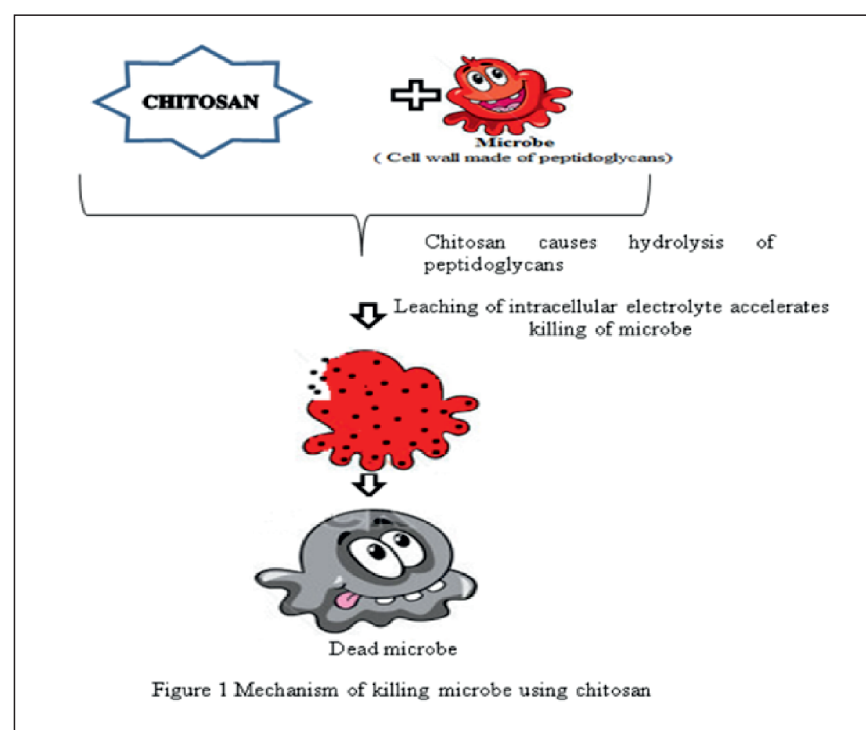
Counterfeit and substandard drugs present unique and complex challenges to the fields of forensic science and criminal justice. These goods seriously threaten public health and safety. Analytical testing can be challenging because forensic analysis of counterfeit drugs typically goes beyond more traditional pharmaceutical methods of drug analysis. The problem is multidimensional and incorporates matters of law, science, criminal justice, public health, and public policy. There is a need to delineate the integral aspects of the counterfeit drug trade if an effective solution is to be proposed. Detection and identification of counterfeit drugs is a critical step in the process of addressing the counterfeit-drug problem. The ability to individualize is the foundation of the discipline of criminalistics and typically the goal of the forensic scientist. Once inside the packaging, physical and chemical characteristics of the dosage form may then be evaluated. If the API is present, further testing is likely required. Counterfeits may have the proper API in the wrong dosage or solid-state form.

## ARTICLES FROM THE DEPARTMENT

### Chitosan: A Promising Biomaterial of 21st Century

Joydeep Dutta

Over the past several decades, the researchers, academicians, and industrialists have shown their strong inclination to work on biomaterials. In this 21st century, chitosan has emerged as an important biomaterial as a consequence of its polycationic nature amongst all the naturally occurring polysaccharides apart from its other exciting and remarkable properties such as biodegradability, biocompatibility, non-toxicity, antibacterial activity, hemostatic efficacy and to name a few. It is a principal derivative of chitin which is abundantly found in the exoskeleton of crustacean shell wastes like shrimp, crab, prawn, lobster, etc. In addition, chitin is also found in the exoskeletons of insects, the cell walls of fungi, and certain hard structures in invertebrates and fish. In nature, chitin can exist in three distinct polymorphic forms namely  $\alpha$ -chitin,  $\beta$ -chitin, and  $\gamma$ -chitin depending on its sources. Usually, it is prepared by the partial deacetylation of chitin in a hot alkali solution. Chitosan is a high-molecular-weight polysaccharide and is composed of N-acetyl glucosamine and acetyl glucosamine units. It can be tailored into various derivatives of interest by modifying its primary amine as well as free hydroxyl groups. It has an excellent film-forming ability. In addition, owing to its intrinsic structural flexibility chitosan can also be given various shapes such as sponge, hydrogel, etc. Therefore, chitosan is still receiving an increased attention of the researchers for its versatile applications such as drug delivery, tissue engineering, wound healing, ophthalmology, water treatment, food packaging, agriculture, dye removal, etc., However, bearing in mind the above-mentioned intrinsic properties of chitosan, a further research on it is still required to explore new applications. Here, the mechanism of killing microbe using chitosan is shown in figure 1.

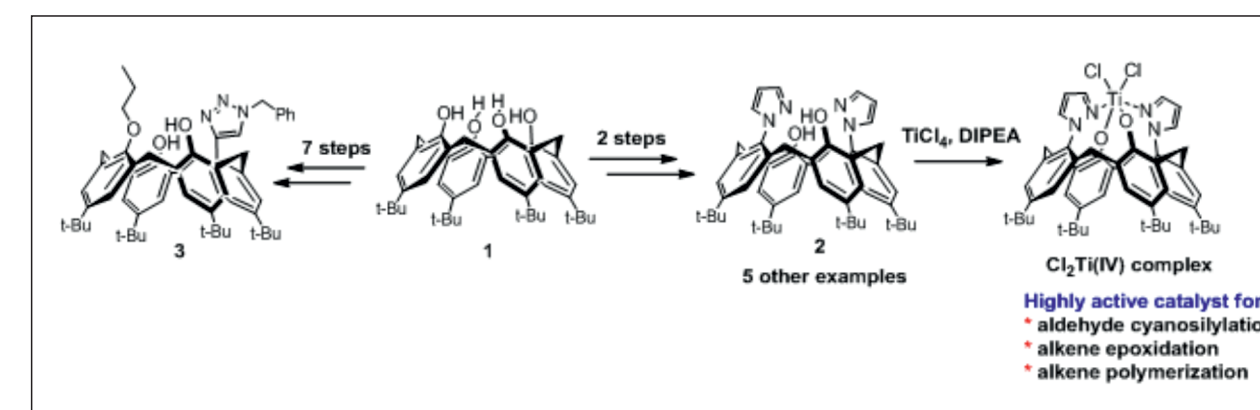


## ARTICLES FROM THE DEPARTMENT

### Calixarene as Omnipresent Catalyst: Synthesis and Application

V. Rawat

Metal complexes of multidentate ligands (Salen and Porphyrin) bearing both hard and soft two electron donors have found numerous applications in catalysis. Most commonly, the soft centers are comprised of imine or phosphine atom, while the hard ones are usually negatively charged alkoxide or amide groups. While transition metal complexes of calixarene **1** have been known for several decades but their catalytic applications received only sparing attention probably because calixarene molecules possess only phenol-based hard donor centers which impair their coordination properties and catalytic behavior. The presence of only hard O-donors also limits the calixarene's use in biomimetic studies as well. To address this issue the present work aims to synthesize different mixed donor calix[n]arene (specifically  $n = 4, 6$ ; from now onwards calixarene) based ligands lacking in one or more oxygen atom. The hard oxygen donor atoms would be replaced by soft donor groups like phosphines, imines, or amines. We will investigate the complexation properties of the new ligands towards transition metals. In particular, complexes of 'softer' metals (Fe, Ru, Co, Cu etc.) will be sought. The complexes will be explored for their use as catalysts in: alkene oxidation, asymmetric ring opening and ring opening polymerization, aldol and Michael addition. They will also be used in dioxygen activation, oxidation of alcohols and C-H bond functionalization.





## ARTICLES FROM THE DEPARTMENT

### Nanotechnology Role in Wastewater Treatment

M. Verma

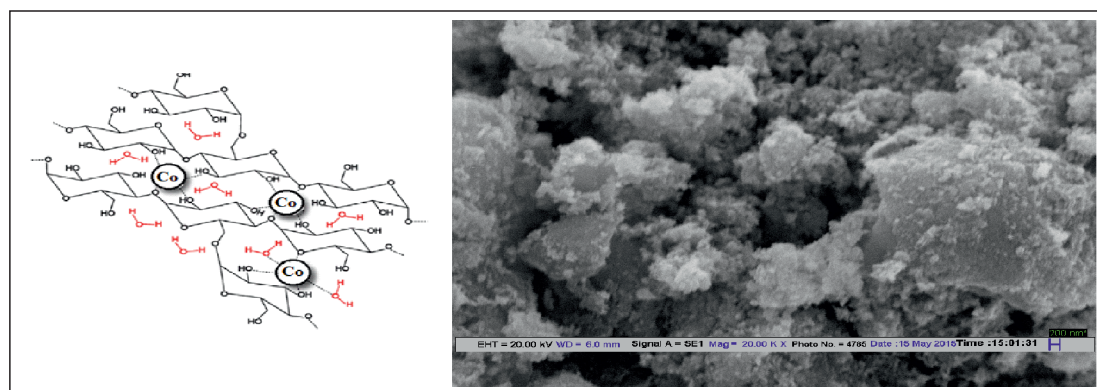
Nanotechnology in water treatment is emerging as a next-gen technology using novel nanomaterials developed in the last two decades. A major advantage of this technology is the possibility of using existing plant structures with only replacement of separation media, which may be a nanomaterial developed as adsorbent, antimicrobial agent, photocatalyst, or nanocomposite membrane. Our group has the main focus to solve the drinking water crisis by wastewater treatment through the scientific truth and vision behind nanofiltration and other avenues through nanotechnology application. The challenge and vision behind this treatise and the immense urge to excel will surely open new dimensions of scientific understanding and adjudication in years to come. Semiconductors play a pivotal role in harvesting solar energy for various processes including the removal of hazardous pollutants from the environment

### Starch Mediated Synthesis of Cobalt Oxide Nanomaterials

D. Vaya

The excessive use of synthetic organic dyes in dyeing industry leaves behind immensely polluted carcinogenic and non-biodegradable waste waters which potentially harm environment and particularly disturb the water ecosystem and aquatic creatures. Heterogeneous photocatalysis is preferable technique as it uses solar energy to convert organic pollutants into simpler and harmless compounds.

An environmentally benign sol-gel method is used for the synthesis of starch mediated Cobalt oxide nanomaterial in a weakly basic medium. Here, starch act as a capping and protecting ligand. Its photocatalytic activity was evaluated by photocatalytic degradation of two model pollutants Malachite Green and Crystal Violet dye. A plausible reaction mechanism is also proposed to illustrate the photocatalytic processes of Cobalt oxide.



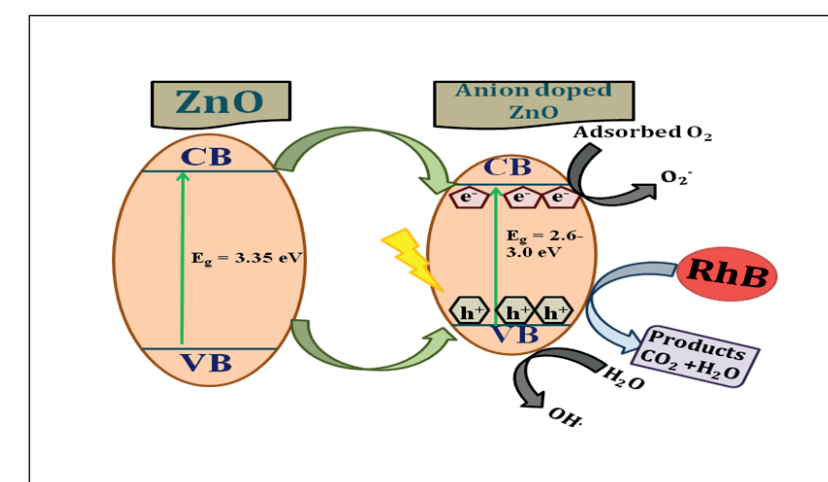
Structure and SEM of modified cobalt oxide nanaomaterials

## ARTICLES FROM THE DEPARTMENT

### An Anion Doped ZnO Nanoparticle for Removal of Dyes from Waste Water

P. Rawat

Metal oxides can play an important role as efficient water purification agents. There is a huge list of metal oxide used but ZnO has drawn special interest because of minimum toxicity, cost effectiveness and easier route of synthesis. Zinc oxide (ZnO), a thermodynamically stable n-type semiconductor, crystallizes in hexagonal P63-mc with a band gap of 3.37 eV and excitons energy 60 meV. The problem which comes with ZnO is its large band gap energy, leading to limited light absorption in the visible region of interest, which imposes a fundamental limitation on overall photo-to-hydrogen efficiency. To overcome this problem substitution of the cation  $Zn^{2+}$  or anion  $O^{2-}$  by an isoelectronic element has been found to modify the band gap of ZnO. Anionic substitutions in metal oxides have attracted the great attention for tuning the band gap of the materials suitable for desired applications. Conduction band in metal oxide derives mainly from the metal orbital, and therefore dopants which substitute for oxygen would cause perturbation of the valence band leading to less scattering of electrons in the conduction band and thus resulting in high electron mobility. We would also use composites synthesis to increase the surface area as well as adsorption properties of such NPs. The synthesized compounds can be used for the removal of carcinogenic dye effluents.

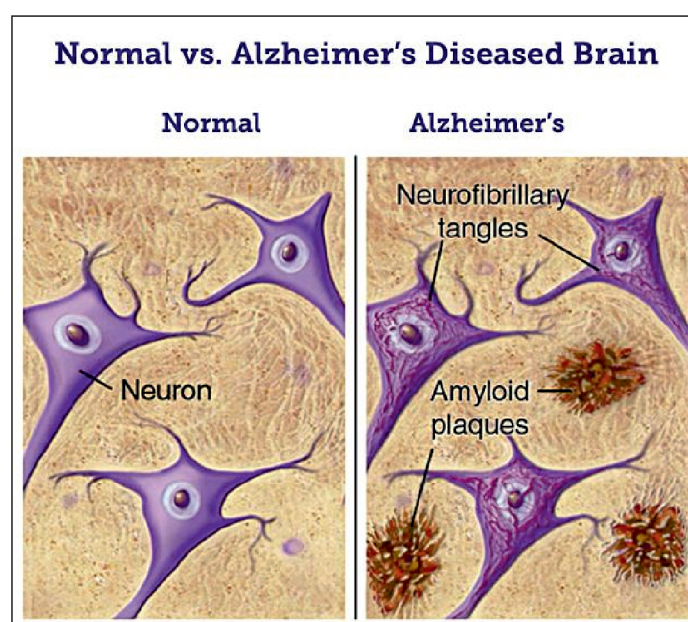


## ARTICLES FROM THE DEPARTMENT

### What Happened to Amitabh Bachchan in Movie 'Black'?

A. Sharma

The protagonist of the movie Black suffered from a mysterious disease wherein he had a mental decline, difficulty in thinking and understanding, forgetfulness etc. Research has shown that the culprit behind his condition is a simple protein molecule that resides in his brain. These protein molecules maintain their natural folded three-dimensional conformation in optimum pH, temperature and solution conditions. However some unknown conditions have the capability to partially or completely unfold these protein molecules. These unfolded forms are now prone to clustering with each other to hide their exposed non-polar residues and thus form large aggregates in the process which eventually precipitate out in the cell's interior or in the extracellular matrix. The formation of these aggregates called amyloid plaques are thought to contribute to the degradation of the neurons (nerve cells) in the brain and the subsequent symptoms of Alzheimer's disease. This protein aggregation also leads to significant loss in the yield of protein in a laboratory or an industrial setup where many therapeutic proteins are produced in large quantities. There is need for a reliable detection technique for the formation of soluble aggregates which start the aggregation process and it may pave the way for development of therapeutic molecules or medicines for the treatment of these debilitating neurodegenerative diseases.



## ARTICLES FROM THE DEPARTMENT

### Forensic Genetics: The Diverse DNA Affair

B. Yadav

Forensic genetics is the blend of legal medicine, genetics and criminalistics and utilizes the technological advancement for the identification and interpretation of the evidences. With the technological enhancement, the resolution of disputes accelerated that provided space for prevention, and enhanced the prosecution investigations. Though, the forensic genetics has been devoted to human most of the time, evidence from nonhuman sources can also be crucial. The use of non-human genome can be best illustrated in criminalistics where perpetrators are clever enough to remove their own biological traces from the crime scene. In these cases, non-human genome can be a silent witness resulting from associative evidence transfer.

The technology which are being conventionally utilized for the genetic identification are: PCR-based methodologies RAPD, ISSR, AFLP, SSR, STR and SNPs. Advanced technologies like, mini STRs, NASBA, LAMP and DNA barcoding and next generation sequencing (NGS) have revolutionized forensic genetics.

The mammalian sex chromosome can be used for gender identification and helped in forensic investigations for resolving paternity and family structures. Non-human genetic materials like soil DNA, knotgrass, mosses etc. are helpful in identifying the human individual who committed a crime. Identification of transmitted strains of pathogens can be helpful in crime investigation even many years after the crime. Species identification, breed variation, origin of seized illegal drugs, endangered and exotic species identification, bioterrorism are the major performance platforms of the non-human forensic genetics. Other applications of forensic genetics include analysis of frauds, outbreaks, transmission of pathogens, biocrimes or accidental release of a biological agent, investigation of the biological composition of food products regarding the species, variety and geographic origin of cultivar. It can also be used for protecting and certifying the quality and source of food. With the increase in genetic data, improved technologies, and vast diversity in genomes, the application of non-human DNA will compete with human DNA in near future for the forensic analysis.



## ARTICLES FROM THE DEPARTMENT

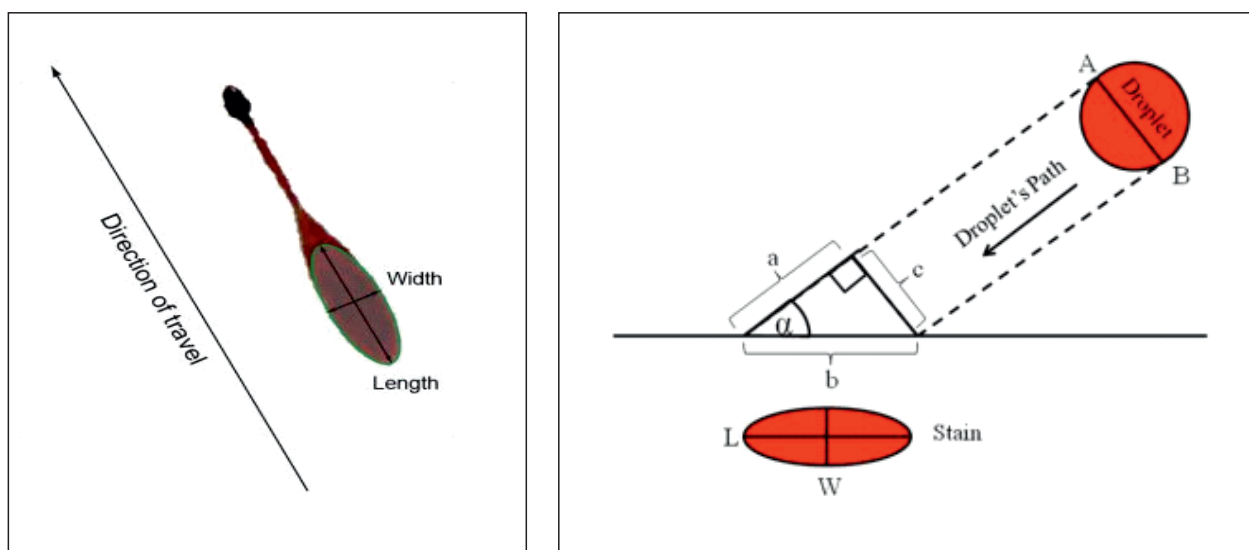
### Blood Spatter Analysis

S. Rohatgi

Blood Spatter analysis involves the study and analysis of bloodstains at a known or suspected violent crime scene for aiding the legal system in catching hold of the culprit. Do you know that Blood has a property to flow and tends to form a sphere in flight rather than a tear drop shape? The formation of sphere is the result of surface tension that binds the molecules together. The presence of blood stains at the crime scene helps the investigator in determining whether the assailant is Right or left-handed, the type and velocity of weapon used for committing the crime, the types of injuries caused by sharp and blunt object. It also helps in determining which wound was inflicted first as well as the position and movements of the victim and assailant during and after attack. There are some interesting facts regarding the distance of blood fall. At a height of about 7 feet due to the air resistance the speed maxes out due to which the speed of the drop increases as well as the diameter. However, size of drop also depends upon volume of drop and the Volume depends upon object from which blood is originated. Bloodstain analysis helps the investigators in the following manner:

**Direction of Spatter /Point of Origin (PO):** The tailing pattern of the blood helps in telling the tale of the crime by determining the point of origin (PO). The narrow end of blood drop will point in the direction of travel. If more than one drop (from spatter) results then the point of origin can be determined.

**Angle of impact with the surface ( $\alpha$ ):** The angle of Impact is the angle at which the blood droplet strikes the surface. Blood spatter analysis can also reveal the truth related to the angle from where the weapon for crime was used as well as the position of the victim and assailant.



## ARTICLES FROM THE DEPARTMENT

### Scope of Forensic Science in India

R. Rohatgi

The field of forensic science is expanding like never before with an upsurge in criminal activities around the world, it requires trained and skilled support to combat crime. With an increase in number of delinquents, we need a large workforce as well which would supplement the investigation and analysis alongside police and judiciary. Thus, forensic science has become an integral part in solving many such criminal cases.

In the simplest of terms, Forensic Science is defined as the application of science to criminal investigations and legal problems. Forensic Science professionals apply the principals and methodologies of science to obtain information relevant to legal and criminal evidence. Forensic Science involves the application of several scientific disciplines such as forensic chemistry, forensic physics, forensic biology and forensic serology, forensic archeology, forensic botany, forensic toxicology, forensic ballistics, questioned documents, fingerprints, forensic psychology, criminology, forensic anthropology, forensic engineering, computer science and digital forensics for evidence analysis.

The field of forensic science includes a multi-disciplinary approach which encompasses scientific and analytical methods to examine and analyze evidences collected from the scene of crime. In India, there are many Universities both Government and Private which offer degree programs in forensic science to students at under-graduate and post-graduate levels. Most of these include hands-on training or internship for students as part of the curriculum. We, at ASAS, also encourage students to take up projects and to innovate and re-search at the campus or at forensic science laboratories. Once the students have acquired the requisite qualification to apply for jobs at different sectors, the scope, in terms of employment enhances. Some of the few places where a forensic expert may be employed are Forensic State Labs and Central Forensic Labs, IB, CBI, State and Centre Police, Banks, Other Cooperate Institutes, Consultants, Private Detectives, and, of course, Teaching.

## ARTICLES FROM THE DEPARTMENT

### Carbon Neutral Fuels: An Alternative for Sustainable Future

G. Rao

Fossil fuel reserves are running out rapidly across the world, escalating the stress on existing oil / coal fields. Additionally, human activities utilizing fossil fuels as a primary energy source, cause dramatic climatic changes and environmental pollution problems. Therefore, there is an urgent need to identify sustainable solutions that can address the future world energy demand. In this context, the reduction of carbon dioxide (CO<sub>2</sub>), considered a potential C1 feedstock to produce fuels, or reduction of water to produce hydrogen is of particular interest. Although being chemically inert, CO<sub>2</sub> and water can be activated naturally as well as artificially. However, only few examples of transition-metal catalysts capable of promoting the essential multi-proton coupled multi-electron transfer steps have been established. Thus, our research is mainly focused on the designing of new molecules (base metal complexes), and exploring their activities towards industrial challenging chemical transformations. We are currently engaged with the designing of new stable and efficient electro- and photo-catalysts for energy application. In addition, we are interested in exploring the potential of these molecular catalysts for small molecule like dinitrogen, hydrogen, CO, CO<sub>2</sub> etc. activation. Other research interests include the designing of new coordination environments for the stabilization of unusual metal oxidation states.

### Nano-Cosmetics: An Emerging Research Field

M. Vats

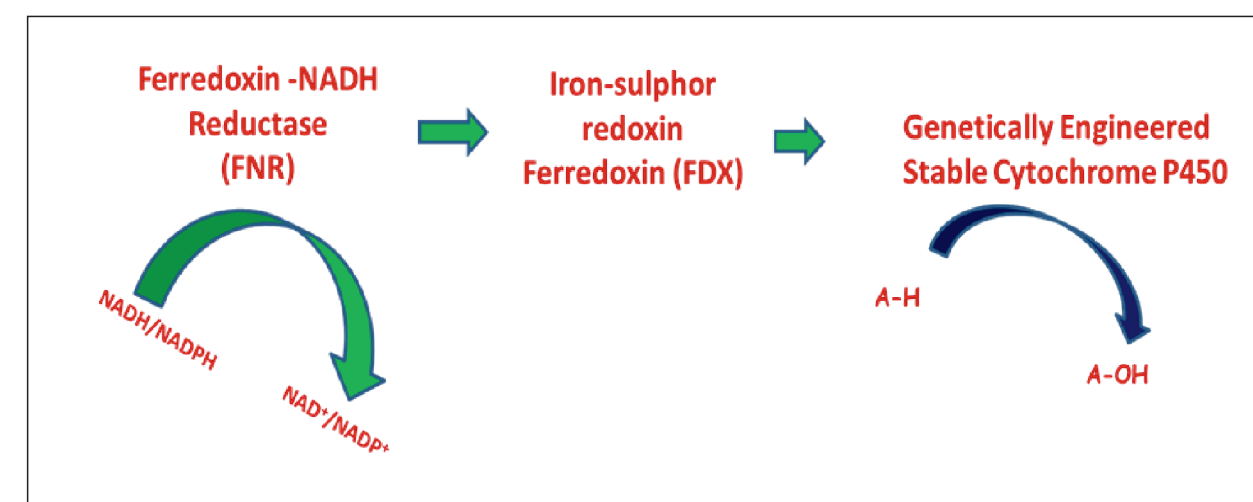
Nanotechnology is rapidly growing due to its application in various fields such as cosmetic industry, pharmaceuticals, agricultural industry, I.T. industries etc. Nanotechnology demonstrates the progress in research and development, by enhancing the efficiency of the cosmetic product/cosmeceuticals. Nano-cosmetic are new and novel in characteristic and application than the conventional cosmetics. Nanotechnology is new technique which is safe as well as effective for cosmetic products preparation. The nanoparticles used for preparing cosmetic and dermal products are innocuous and safe because of their bio-degradable nature and effective due to long lasting effects and their ability to penetrate deep into the skin. Nanocosmetics can be used for nail, skin, hair and lip care for photo aging, dandruff, hair damage, wrinkles, hyperpigmentation, etc. The nanoparticles like liposomes, niosomes, nanoemulsions, nanostructured lipid, and nanospheres have been used in preparing cosmeceuticals. They show controlled and sustained drug release, high stability, target specific, higher efficiency and deep skin penetration. However, they also pose a concern in the form of nanoparticles toxicity, by penetrating deeper through skin and causing health hazards. There are different companies which synthesize the nanoparticles incorporated cosmetic products and are successfully available in market. The effectiveness of these nanoparticles can be increased in the near future.

## ARTICLES FROM THE DEPARTMENT

### Directed Evolution of Stable Cytochrome P450: An Approach for Alkane Hydroxylation

M. Shandilya

Hydroxylation of medium and long chain alkanes and its conversion into valuable alcohols is a challenging task in organic chemistry. However, nature has provided a solution for alkanes hydroxylation via biocatalysis with monooxygenases such as methane mono-oxygenase (MMO), alkane hydroxylase (AlkB) and Cytochrome P450 monooxygenase as efficient catalysts. The possibility of using these biocatalysts for large-scale applications is hampered because of thermal instability and requirement of redox partner proteins for electron transfer during catalysis. In this study, directed evolution of the thermostable P450 using site-saturation mutagenesis has been investigated to achieve efficient alkane hydroxylation. In addition, redox partner proteins- ferredoxin (Fdx) and ferredoxin NAD(P) Reductase (FNR) are used to develop cell-free enzyme complex system to drive the reductive pathway of the catalytic cycle. The results of UV-visible absorption spectra of co-expression fractions and purified proteins showed the characteristic absorption bands of all three proteins. Far-UV CD and visible CD spectra analysis confirmed the properly folded secondary and tertiary structure of all three proteins. However, MALDI spectrum partially supports the co-expression of Cytochrome P450, FNR and Fdx. The fluorescence emission spectrum of co-expression fraction and separately purified FNR showed the emission band at ~450nm supporting the expression of FNR. Now our main focus is to evolve stable cytochrome P450 through saturation mutagenesis and high throughput screening of active mutant through GCMS.



## ARTICLES FROM THE DEPARTMENT

### Eco-friendly Biodegradable Polymer Nanocomposites; Polymer Packaging

A. P. Gupta, HOD, Centre for Polymer Technology

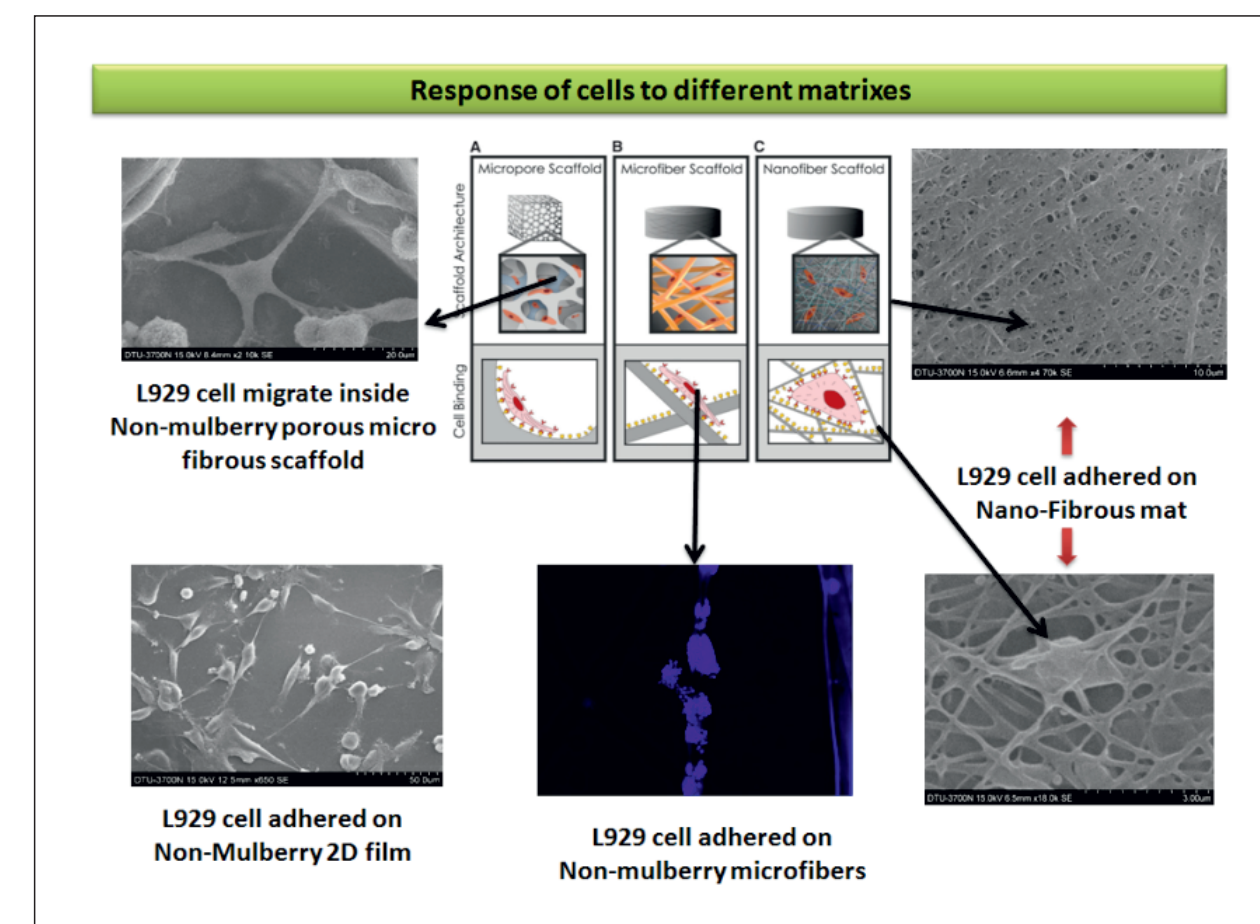
Polymer composites are the materials made of two components i.e. discrete phase (reinforcement) and continuous phase (polymer). Polymer nanocomposites fall under the category of composites in which at least one phase is in nanodimension. Due to nonbiodegradable nature, littering of conventional plastic packaging emerges as a major environmental problem. Various types of biodegradable polymer packaging materials such as Poly-Lactic acid, Poly glycolic acid, Poly lactic-co- glycolic acids, guar gum, chitosan, gelatin, glycerol modified starch etc. are available commercially. Still, there is a need to develop cost effective and high performance biodegradable polymer packaging materials. Different types of natural fibers such as cotton, silk, jute, coir and flax have been successfully incorporated as reinforcing agents for the preparation of polymer composites. In order to further enhance the physico-chemical, mechanical, barrier and biological properties of different nanomaterials, such as Sodium Montmorillonite (NaMMT), Cloisite, SiO<sub>2</sub>, ZnO, TiO<sub>2</sub>, Graphene, Carbon Nanotubes, Talc etc. have been successfully incorporated as nano-reinforcing agents. These biodegradable polymer nanocomposites may also be fabricated in the form of film which has very good mechanical strength, barrier properties and excellent environment stress cracking resistance. On account of these properties, these films are very much selective for packaging applications, especially food and drug packaging.

## ARTICLES FROM THE DEPARTMENT

### Nonmulberry Silk Fibroin Matrices as Potential Materials for Skin Tissue Engineering

C. M. Srivastava, Centre for Polymer Technology

India is rich with wide varieties of silk including mulberry, muga, tasar, eri and spider silk, out of which muga, tasar and eri silk is also known as nonmulberry silk. Regenerated nonmulberry silk fibroin proteins showed tuned mechanical properties and controlled biodegradability. Recently, it is explored that nonmulberry silk fibroin proteins show higher cellular compatibility due to the presence of R(Arg)-G(Gly)-D(Asp) sequence that enhances the binding of negative charge cell surface with positive charge arginine residue. But due to the poor solubility in wide varieties of solvents, these nonmulberry fibroin proteins are nearly unexplored and most of the study on these proteins was restricted only to the water-soluble gland proteins extracted from silkworm. In the last few years, researchers have regenerated these cocoons extracted nonmulberry silk fibroin proteins using ionic liquids in the form of 2D film, 3D scaffolds, nanofibers and cryogels for tissue engineering application. We also found that nonmulberry silk fibroin proteins showed very good cellular compatibility and respond differently with different matrices architecture.





## ARTICLES FROM OUTSIDE THE DEPARTMENT

### XPS Analysis of CVD Deposited Graphene on Cu by Ethanol Decomposition

R. Brajpuriya, Amity Institute of Nanotechnology, AUH

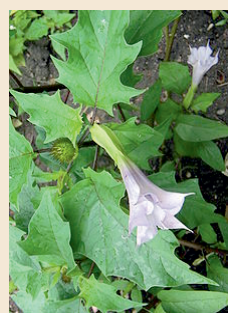
Graphene, two dimensional, single atomic layer of covalently bonded material with honeycomb structure, has been blessed with numerous unprecedented properties such as high electrical and thermal conductivity, high elasticity, and transparency, that promises to revolutionize the fields of data storage and energy storage. But for this potential to be fully realized, meaningful quantities of the material need to be produced economically and at a consistent quality. Current graphene manufacturing processes are complicated and generally offer unpredictable results regarding the material's quality. Among many methods, considering its low cost, scalability and high efficiency, we found chemical vapor deposition (CVD) method to be the most promising scalable method for producing graphene for large-scale manufacture. Therefore, in the present work, the use of ethanol, an economic and safe precursor, for the fast growth of graphene on copper was analysed. X-ray photoelectron spectroscopy core level study has been carried out to check the cleanliness and the quality of the grown graphene. D-parameter (19.5 eV) obtained from carbon Auger feature (C-KVV) and dominated single peak at 284.5 eV assigned to the sp<sup>2</sup> graphitic C=C confirms the film deposited on Cu is graphene is clean with no contaminants.

### Botanical Weapons- Modus Operandi from Ancient Era by Criminals

B. Yadav

Department of Forensic Science, SGT University, Gurugram

Forensic Botany is the application of plant science to criminal investigations. From the view of Forensic Investigations, criminals use plant and its constituents in Modus Operandi in execution of crime. Every criminal adopts a significant modus operandi that means a way of execution or mode of operation for committing a successful crime. Some of the plants used are highly toxic and is used in Homicidal, Suicidal, Accidental and mostly in cattle poisoning. Application of Forensic Botany include evidence in link to object or location, evidence in clandestine graves and evidences in estimating time elapsed since death. Some of the highly toxic plants are -



#### **Datura stramonium**

Contains dangerous levels of toxins which are classified as deliriant or anticholinergic. The risk of fatal overdose may induce psychological effects and eventually death.

**Main Toxins:** tropane, alkaloids, atropine, hyoscyamine, and scopolamine.

**Common Symptoms:** hyperthermia, tachycardia mydriasis, photophobia

#### **Abrus precatorius**

*Abrus precatorius* commonly called as jequirity. The plant is best known for its seeds, which are used as beads and in percussion instruments, and which are toxic because of the presence of abrin. Ingestion of a single seed, when chewed, can be fatal to both adults and children.

**Main Toxins-** Abrin

**Common Symptoms-** nausea, vomiting, convulsions, liver failure, and death

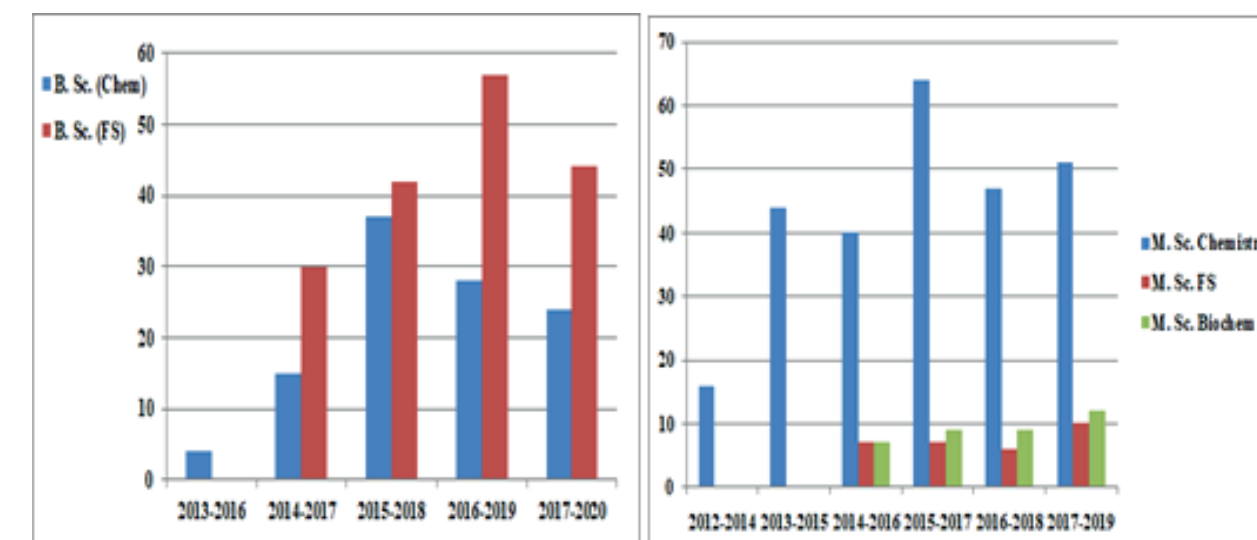
## ABOUT THE DEPARTMENT

Department of Chemistry, Biochemistry & Forensic Science was established under the aegis of Amity School of Applied Sciences, Amity University Haryana in 2012 with a vision to be a department of excellence in Chemistry with UG, PG and PhD programs. In 2014, we started a PG and PhD course in Biochemistry along with UG, PG and PhD programs in Forensic Science. The main thrust and philosophy behind the establishment of this interdisciplinary department was to promote in-depth undergraduate & post graduate education and research in emerging areas of Chemistry, Biochemistry & Forensic Sciences that will be beneficial for the nation and the world at large. The curricula designed are comprehensive and are comparable to the International Standards. The department caters to the placements in academia and industry and it subscribes to the deep and sustained belief that application of principles of natural sciences in technology can bring about substantial advances in society.

## ACADEMIC PROGRAMS

Department of CBFS is an interdisciplinary department in true sense. The Department offers BSc (H) programs in Chemistry and Forensic Science at undergraduate level and MSc and PhD program in Chemistry, Biochemistry & Forensic Science. Department also gives freedom to students to design their own degree by offering minor tracks (FLEXI) in Pharmaceutical and Cosmetics Chemistry along with Computer Forensics & Cyber Security. The department had an accelerated growth in past 7 years.

## ENROLLMENTS OVER THE YEAR





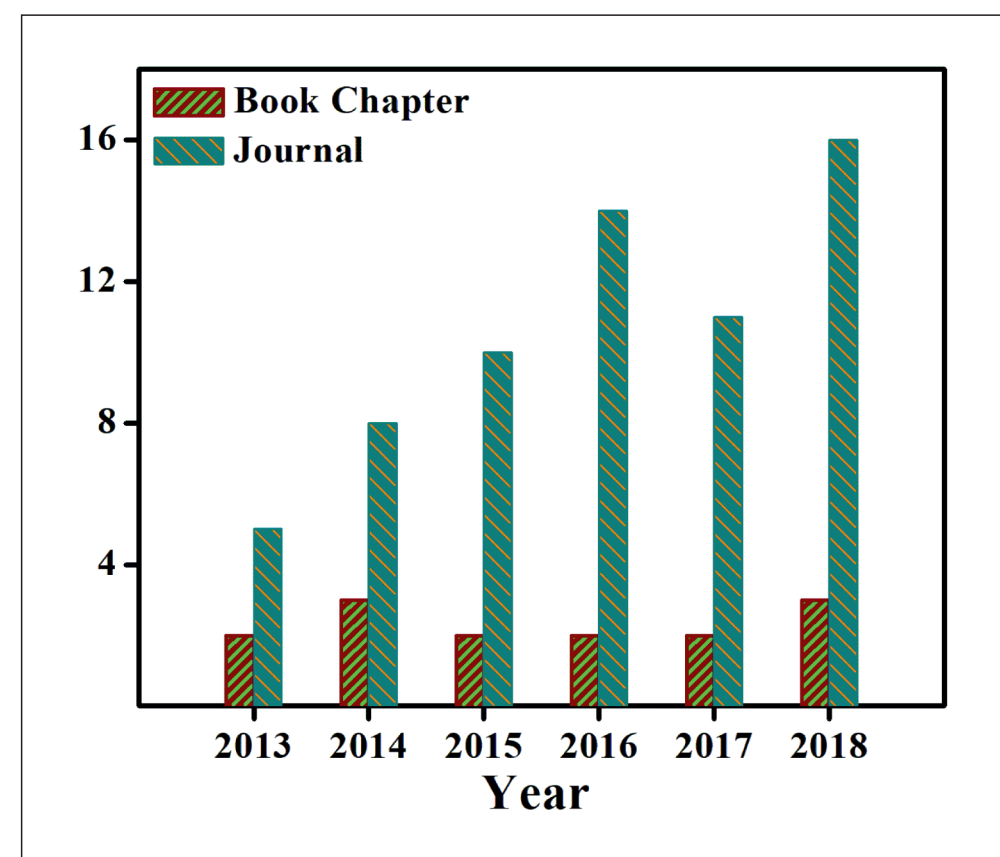
## INSTRUMENTS



## RESEARCH OUTPUTS 2012-18

S.No.	Particulars	No.
1	Research Publications	68
2	PhD Scholars	23
3	PhD awarded	3
4	Books/Chapters Published	13
5	Patents Filed	4
6	International Visits	4
7	Funded Projects Sanctioned	2

## PUBLICATIONS/ BOOKS CHAPTERS





## RESEARCH PROJECTS

S.No	Name of the PI/Co-PI	Title of the Project Proposal	Budget (Rs)	Funding Agency
1	Anurag Sharma, Seema R Pathak	Evaluation of the biological activity of heparin attached to hollow fiber membrane.	1,84,455/- 3174\$	Applied Membrane Technology Inc. Minnetonka, Minnesota, USA
2.	Anurag Sharma	Use of Extraneous surface s in the form of hollow fiber membranes to control the aggregation of some proteins.	1,84,455/- 3174\$	Applied Membrane Technology Inc. Minnetonka, Minnesota, USA

## PATENTS

S. No	Name	Title	Remarks
1	D Archana, J. Dutta and P K Dutta	A wound care product (No. 1267/DEL/2015)	National Patent filed
2	J Dutta and D. Ghosh, A. S. Majumdar, G. Dwivedi, C. Vishvanand	Hydrogel Composition (No. 2561/MUM/2008)	National Patent published
3	S. Das, S. Majumder, Nisha	CoolB- An Absorbent for Vapour Absorption Refrigeration System	National Patent filed
4	S. R Pathak, M. Mann, S. K. Shukla	Sequence of Strokes Kit	National Patent filed

## INTERNATIONAL VISITS SPONSORED BY AUH

S. No	Name	Department	Event Title	Country	Event Year
1	Dr. Monika Vats	Chemistry	Global Advanced Material and Surface Forums	Dubai	2015
2	Dr. Nidhin	Chemistry	Golden Jubilee Chemistry Conference-2015	Singapore	2015
3.	Dr. Bhuvnesh Yadav	Forensic Science	International conference on Innovative approaches in applied sciences and technologies (ICIAST 2017), Nanyang Technological University	Singapore	2017
4.	Dr. Priyanka Bolel	Chemistry	Project Name "Development of Nanophosphors for Solid State Lighting: Electronic Structure and Luminescence related study" sanctioned by UGC -DAE-CSR Indore.	Department of Health Sciences Ben-Gurion University of the Negev, Israel	2017

## BOOKS/ WORK BOOKS

- Chemistry Practical Work Book for B.Tech. students, S.S. Knowledge Publication; 2010 by Seema R. Pathak, Sangeeta Pandey, 2013.
- Chemistry Tutorial Work Book for B.Tech. students, S.S. Knowledge publication; 2012 by Seema R. Pathak, Sangeeta Pandey, 2013.
- M. Nidhin, "Industrially Relevant Nanoparticles Hematite: its synthesis, functionalization and Applications" CRC press, Canada, ISBN: 9781926895796, 2014.
- M Nidhin, K J Sreeram and B U Nair "Advanced Nanomaterials – Industrially Relevant Nanoparticles – Hematite: Its Synthesis, functionalization and Applications" Apple Academic Press (AAP), Canada, ISBN: 9781926895796, 2014.
- J. Dutta "Polysaccharides, Bioactivity and Biotechnology, Isolation, purification and nanotechnological applications of chitosan Springer-Verlag Berlin Heidelberg, 2014.
- S. Mehta, R. Kumar, M. Vats, A. Sharma and S. R. Pathak "Biotechnology Progress and Applications (Biological Significance of Coumarin Derivatives)" Astral International Pvt. Ltd. New Delhi ISBN 9789351309505, 2016.
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- R. Rohatgi "Environment, Development, Public Policy and Health- Anthropological Perspectives- Novel SPR composition for developing latent prints on wet surfaces" B.R. Publishing Corporation ISBN: 9789350502754, 2017.
- R. Rohatgi "Anthropology and Forensic Science - Dermal ridge density variability among Delhi population and its forensic application to sex determination" SSB Publisher & Distributor, ISBN no. 9788189128647, 2017.
- M. Mann and S. R. Pathak "Synthesis of Medicinal Agents from Plants, Ayurveda: A new dimension in the era of Modern Medicine" Elsevier, ISBN: 9780081020715, 2018.
- R. Kumar, S. Mehta and S. R Pathak, "Synthesis of Medicinal Agents from Plants – Bioactive constituent of Neem" Elsevier, ISBN: 9780081020715, 2018.
- A. Thakur, S.R. Pathak, "Synthesis of Medicinal Agents from Plants-Introduction to Medicinal Important Constituent from Chinese Medicinal Plants" Elsevier ISBN : 9780081020715, 2018.
- V. Rawat "Pesticides as Water Pollutants" IGI Global: ISBN: 1522561110, 2018



## PEER REVIEWED PUBLICATIONS

S. No.	Journal Title	Volume/ page no. / Year	Paper Title	Authors Name
1	Journal of Punjab Academy of Forensic Medicine and Toxicology	ISBN:0972-5687 (2018) 50-53	Determination of the Sequence of Strokes Made from the Same Color and Type of the Ink	Manisha Mann, Dr. S.K. Shukla and Dr. Seema R Pathak
2	Innovations in Science. Technology and Management, challenges and opportunities	ISBN: 978-93-86724-43-4 (2018) 23	Effect of writing papers on sequence of intersecting lines	Manisha Mann, Dr. S.K. Shukla and Dr. Seema R Pathak*
3	Central Nervous System Agents in Medicinal Chemistry	Accepted (2018)	Novel Imidazoline derivatives as potential CVS & CNS agents	Malhotra V., Vats M., Nath R., Mehta S., Kumar R., Bhalla, M., Sinha J.N., Shanker K., Pathak S.R.
4	7 <sup>th</sup> Indian Chitin and Chitosan Society	October 11-13, 54 (2018)	Physicochemical assessment of nanocomposite wound dressing films based on chitosan-halloysite nanotubes	Devi N, Dutta J.
5	7 <sup>th</sup> Indian Chitin and Chitosan Society Meeting", NCL, Pune	October 11-13, 82 (2018)	A facile approach to synthesize water soluble chitosan succinate nanoparticles	Priyanka, Dutta J.
6	7 <sup>th</sup> Indian Chitin and Chitosan Society Meeting", NCL, Pune	October 11-13, 70 (2018)	Effect of degree of deacetylation and molecular weight on physicochemical properties of various chitosan films	Mohini, Dutta J.
7	7 <sup>th</sup> Indian Chitin and Chitosan Society Meeting", NCL, Pune	October 11-13, 50 (2018)	Assessment of hemostatic efficiency of carboxymethyl chitosan-alum based biocomposite films	Bhawna, Dutta J.
8	Journal of Polymer Materials	14 (2018) 13-20	Preparation of cinnamon oil encapsulated chitosan/alginate hydrogel composite for food and wound healing applications	Kashyap M., Archana D., N., Dutta J., Dutta P. K.
9	Asian Journal of Pharmaceutics	12 (2018) 1-5	Bioavailability enhancement of poorly water-soluble nano diosgenin by encapsulation using chitosan/bovine serum albumin bilayers	Kumar R., Mehndiratta P., Mishra N., Thukral A., Pathak S.R., Singh R.
10	Nanoscience and Nanotechnology-Asia	8 (2018) 1-11	Green Synthesis of Cobalt Oxide Nanoparticles by a Starch-Assisted Method	Vaya D., Meena, Das B.K.
11	Research Journal of Pharmacy and Technology	11(2018)	Laser- A boon for forensic science	Rohatgi S, Gupta S., Sharma M.
12	Research Journal of Pharmacy and Technology	10 (2018) 4085-4089	A study to focus on augmentation of pre-existing methodologies for tampered document examination	Rohatgi S., Gupta S., Sharma M., Shukla S.K.
13	Journal of Applied Pharmaceutical Science	8 (2018) 144-150	Synthesis, Characterization of Novel PLGA Encapsulated Indole Nanoparticles and Study of its cytotoxic potential against A549 lung cancer cell line	Majumder S., Sharma N., Das S., Pandey N., Srivastava T., Ghosha D.
14	Materials Chemistry and Physics	212 (2018) 268-273	Synthesis of ZrO <sub>2</sub> nanoparticles using reactive magnetron sputtering and their structural, morphological and thermal studies	Verma M., Kumar V., Katoch A.
15	Indian Journal of Chemistry Sec A	57 (2018) 1-5	Unusual redox activity of composite alkaline earth metal oxide and reduced modelling oxide system	Majumder S., Sharma S., Ghosh D., Joon P., Sinha C.

## PEER REVIEWED PUBLICATIONS

S. No.	Journal Title	Volume/ page no. / Year	Paper Title	Authors Name
16	Indian Journal of Chemistry Sec A	57 (2018) 1151-1155	Role of polyvinyl pyrrolidone as capping agent in the synthesis of magnetite (Fe <sub>3</sub> O <sub>4</sub> ) nanoparticles	Kumari S., Yadav N., Debasree G., Srivastava C. M., Majumdar S.
17	International Journal of Human Genetics	17 (2017) 151-157	Genetic ancestry of a Delhi population as inferred from autosomal STRs	Yadav B., Raina A., Balayan A., Dogra T.D.
18	Asian Chitin Journal	13 (2017) 13-18	Effect of various Neem ( <i>Azadirachta indica</i> ) and Tulsi ( <i>Ocimum sanctum</i> ) extracts on physicochemical Properties of chitosan films	Deepika, Devi N., Dutta J.
19	Journal of Punjab Academy of Medicine and Toxicology	17 (2017)55-59	Paternity Suspicion: Paranoia in India	Raina A., Balayan A., Dogra T.D.
20	International Journal of Biological Macromolecules	104 (2017)1897-1904	Preparation and characterization of chitosan-bentonite nanocomposite films for wound healing application	Devi N., Dutta J.
21	Journal of Polymer materials	34 (2017) 33-44	Preparation and characterization of chitosan based hydrogel formulation by using acetic acid and propylene glycerol for wound healing application	Kashyap M., Dutta J., Dutta P.K.
22	Journal of Polymer Materials	34 (2017) 21-31	Development & physicochemical properties of chitosan/starch/bentonite based ternary nanocomposite film for wound healing	Dutta, J., Devi, N
23	International Journal of Biological Macromolecules	99 (2017) 655-664	Role of nanoparticle size in self-assemble processes of collagen for tissue engineering application	Vedhanayagam M., Nidhin M, Duraipandy N., Dhanasekar N, Jaganathan G., Ranganathan M, Kiran M.S., Narayan S., Nair B.U., Sreeram K.J.
24	Indian Chemical Society	2017	Effect of halloysite on physicochemical properties of chitosan/starch/halloysite nanotubes ternary nanocomposite film	Devi N., Dutta J.
25	Journal of Molecular Graphics and Modelling	75 (2017) 233-240	Understanding the molecular basis of stability in Kunitz (STI) family of inhibitors in terms of a conserved core tryptophan residue: A theoretical investigation	Sharma RD, Ghosh D, Goswami D, Majumder S
26	Asian Journal of Pharmaceutical and Clinical Research	10 (2017) 335-340	In Silico Drug design and molecular docking studies of novel coumarin Derivatives as anticancer agents	Pathak S.R., Mehta S
27	Frontiers in Immunology	2017	Targeting Multiple Tumours Using T-Cells Engineered to Express a Natural Cytotoxicity Receptor 2-Based Chimeric Receptor	Sarkar R, V. Eisenberg
28	RSC Advances	6 (2016) 28640-28652	"Differential influence of additives on the various stages of insulin aggregation"	Saha S, Sharma A, Deep S

## PEER REVIEWED PUBLICATIONS

S. No.	Journal Title	Volume/ page no. / Year	Paper Title	Authors Name
29	Asian Chitin Journal	12 (2016) 1-4	A novel chitosan-bentonite nano composite films for wound healing application	Dutta J, Devi N, Devi A.
30	Asian Chitin Journal	12 (2016) 15-22	Preparation and characterization of chitosan based hydrogel formulation by using acetic acid and glycerol for wound healing application	Kashyap M, Dutta J, Dutta PK.,
31	Analytical Methods	8 (2016) 2805- 2811	Reorganization energy and Stokes shift calculations from spectral data as new efficient approaches in distinguishing the end point of micellization/aggregation	Halder, M., Datta, S., Bolel, P., Mahapatra, N., Panja, S., Vardhan, H., Kayal, S., Khatua, D.K., Das, I
32	International Journal of Pharma and Bio Sciences	7 (2016) 291-304	Molecular Docking and adment studies of 3-Phenyl coumarin derivatives for their anticancer activity	Mehta S., Sumit, Goyal N., Oyal, Pathak S.R.
33	www.IJoFCS.org	10 (2016) 15-22	FraaS: A Framework for Digital Forensic Services in a Cloud-based Environment	Soni M., Bharti M.K.
34	J. of Indian chemical society	93 (2016) 907-912	A niche market survey of wound care products and emergence of nanotechnology- A short review	Devi, N., Dutta, J.
35	Nanoscience& Nanotechnology-Asia	6 (2016) 135-145	Green Synthesis of Silver Nanoparticles Using Leaf Extract of Helianthus annuus & Mentha longifolia and Screening of their Antimicrobial Activity Against Escherichia coli	Yadav P., Gautam S., Debnath N., Ghosh D., Majumder S.
36	"Fusion of Science & Technology"	2016, 518-522	Synthesis and Characterization of Transition Metal Oxide Nanoparticles and Their Application as Heat Transfer Fluids	Majumder S., Dhiman S., Yadav D., Varshney N., Joon P., Das S.
37	Anal. Methods	8 (2016) 2805– 2811	Reorganization energy and Stokes shift calculations from spectral data as new efficient approaches in distinguishing the end point of micellization/aggregation	Halder M, Datta S, Bolel P, Mahapatra N, Panja S, Vardhan H, Kayal S, Khatua D. K, Das I.
38	5 <sup>th</sup> International symposium of Fusion of Science and Technology, ISFT-2016	ID No.: 2016- ISFT-372	Efficient Synthesis and characterization of Transition Metal Oxide Nanoparticles and their Application as Heat Transfer Fluids	Dhiman S, Yadav D, Varshney N, Joon P, Das S, Majumder S.
39	Chemico-Biological Interactions	254 (2016) 221-230	Transition metal oxide nanoparticles are effective in inhibiting lung cancer cell survival in the hypoxic tumor microenvironment	Pandey N., Dhiman S., Srivastava T., Majumder S.
40	Indian Chemical Society	2016, C 33	Effect of bentonite on chitosan based nanocomposite film as a wound dressing	Devi N, Dutta J.
41	Asian Pacific Chitin Chitosan Symposium	2016, 136	Preparation and characterization of chitosan-bentonite nanocomposite films for wound healing application	Devi N, Dutta J.
42	Journal of Photochemistry and Photobiology B: Biology	148 (2015) 88-100	Mode of action of tin-based anti-proliferative agents: Biological studies of organo tin (IV) derivatives of fatty acids	Nath M, Vats M, Roy P.
43	International Journal of Biological Macromolecules	73 (2015) 49-57	Chitosan-PVP- nano silver oxide wound dressing: In vitro and in vivo Evaluation	Archana D, Singh BK, Dutta J, Dutta P.K.

## PEER REVIEWED PUBLICATIONS

S. No.	Journal Title	Volume/ page no. / Year	Paper Title	Authors Name
44	Asian Chitin Journal	11 (2015) 33	Preparation of chitosan-gelatin based composite gels/films as wound cover materials	Gayatri and Dutta J.
45	Asian Chitin Journal	11 (2015) 1- 6	A mini review on chitin/chitosan based wound dressings from shrimp and crab sources	Devi N, Dutta J.
46	The International Advanced Materials & Surface Forum, GAMS	2015	Synthesis, Characterization and Applications of Iron Oxide, Nanoparticles in Cosmetics, Sector Conference	Vats M, Nidhin M, Pathak SR, Sreeram KJ.
47	International Journal of Current Engineering & Technology	5 (2015) 2500- 2503	Effect of addition of Hydrophobic Hydrocarbons on the Hygroscopic Tendency of Ammonium Nitrate Crystals	Bharti MK, Aggarwal R, Kami P, Pathak SR, Soni M.
48	Biochimica et Biophysica Acta (BBA)-Proteins and Proteomics	1864 (2015) 55-64	A Conserved W91 residue determines the packing of Kunitz (STI) family of inhibitors Theoretical & Experimental Investigation	Majumder S, Khamrui S, Banerjee R, Bhowmik P, Sen U.
49	Cognition-2015(Proceedings)	2015, 76-82	A review of Forensic Artcraft in A window 8 Environment, Innovations in Computing & Information Technology	Soni M, Pathak SR.
50	Soft Materials	13 (2015) 59-651	Collagen-nanoparticle Interactions: Type I Collagen Stabilization Using Functionalized Nanoparticles	Aswathy K, Sangeetha S, Nidhin M, Sreeram KJ, Fathima NN
51	Material Science and Engineering B	202 (2015)	Structural & Functional aspects of Trypsin-Gold Nanoparticle Interactions: An Experimental Investigation	Nidhin M, Ghosh D, Yadav H, Yadav N, Majumder S.,
52	Central Nervous System Agents in Medicinal Chemistry	14 (2014) 34-38	Synthesis and antihypertensive activity of novel Quinazolinone derivatives	Pathak R, Malhotra V, Nath R.
53	Journal of proteins and proteomics,	2014, 5(1)	Assessment of loop rigidification in enzyme-inhibitor complexes: a quantitative and probabilistic study	Majumder S, Mitra R.
54	Scientific Reports, Nature publishing group	4 (2014) 5968 (1- 10)	Fluorescent nanonetworks: A novel bioalley for collagen scaffolds and Tissue Engineering	Nidhin M, Vedhanayagam M, Selvam S, Kiran MS, Nazeer SS, Jayasree R, Sreeram KJ., Nair BU.,
55	Journal of American Leather Chemists & Technologist Association	109 (2014) 184-188	Green synthesis of monodispersed iron oxide nanoparticles for Leather Finishing	Nidhin M, Aravindhan R, Sreeram KJ
56	Inorganica Chimica Acta	423 (2014) 70-82	Design, spectral characterization, anti-tumor and anti-inflammatory activity of triorganotin (IV) hydroxycarboxylates, apoptosis inducers: in vitro assessment of induction of apoptosis by enzyme, DNA-fragmentation, acridine orange and comet assays.	Nath M, Vats M, Roy P.
57	Asian Chitin Journal	10 (2014) 1- 10	Chitosan for wound healing management via in vivo approach: A mini review.	Archana D, Dutta J, Dutta PK.
58	Proceeding of ICCS	2014	Sources: Processing of chitin and chitosan	Dutta J.

## PEER REVIEWED PUBLICATIONS

S. No.	Journal Title	Volume/ page no. / Year	Paper Title	Authors Name
59	Proceeding of ICCS	2014	Chitin extraction from fish scales of Rohu (Labio rohita)	Sharma S, Dutta J.
60	European Journal of Medicinal Chemistry	59 (2013) 310-321	Tri-and diorganotin (IV) complexes of biologically important orotic acid: synthesis, spectroscopic studies, in vitro anti-cancer, DNA fragmentation, enzyme assays and in vivo anti-inflammatory activities	Nath M, Vats M, P Roy..
61	Carbohydrate Polymers	97 (2013) 327-334	<i>In Vivo</i> Evaluation of chitosan-PVP-titanium dioxide nanocomposite as wound dressing material	Archana D, Singh BK, Dutta J, Dutta PK.
62	International Journal of Biological Macromolecules	57 (2013) 193–203	Evaluation of chitosan nano dressing for wound healing: Characterization, in vitro and in vivo studies	Archana D, Dutta J, Dutta PK.
63	RSC Advances	3 (2013) 6906-6912	Flower shaped Assemble of Cobalt Ferrite Nanoparticles: Application as T2 Contrast agent in MRI	Nidhin M, Nazeer SS, Jayasree RS, Kiran MS, Nair BU, Sreeram KJ.
64	Indian Journal of Biotechnology	12 (2013) 475-482	Chitosan-pectin-alginate as a novel scaffold for tissue engineering applications	Archana D, Upadhyay L, Tewari RP, Dutta J, Huang YB, Dutta PK.
65	Applied Surface Science	258 (2012) 5179–5184	Polysaccharide films as templates in the synthesis of hematite nanostructures with special properties	Nidhin M, Sreeram KJ, Nair BU.
66	Chemical Engineering Journal	185–186 (2012) 352–357	Green synthesis of rock salt CoO nanoparticles for coating applications by complexation and surface passivation with starch,	Nidhin M, Sreeram KJ, Nair BU.
67	Proceedings of the National Seminar on Biological & Pedagogical Chemistry	10-11 Feb 2012	Novel Substituted Benzimidazoles Derivatives as potential Hypoglycemic Compounds. Biological & Pedagogical Chemistry	Pathak SR, Pandey VK
68	Bioorganic & Medicinal Chemistry Letters	21 (2011) 936–939	Substituted imidazole derivatives as novel cardiovascular agents	Malhotra V, Pathak SR, Nath R, Mukherjee D.

## FACULTY PROFILE



**Prof. Seema R. Pathak**

Hod, CBFS

**Qualification:** PhD (Lucknow University)

**Research Area:** Synthesis & Medical Application of Coumarin Derivatives, Questioned Document



**Prof. Joydeep Dutta**

**Designation:** Professor of Chemistry

**Qualification:** PhD (university of Allahabad)

**Research Area:** Tissue Engineering, Wound Healing, Biomaterial, and Nanotechnology



**Dr. Sudip Majumder**

**Designation:** Assistant Professor of Chemistry

**Qualification:** PhD (Saha Institute of Nuclear Physics, Kolkata)

**Research Area:** Application of Nanomaterials, Structural Biology & Bioinformatics



**Dr. Monika Vats**

**Designation:** Assistant Professor of Chemistry

**Qualification:** PhD (Indian Institute of Technology, Roorkee)

**Research Area:** Organometallic and Bioinorganic Chemistry, Chemistry of Cosmetic Materials



**Dr. Anurag Sharma**

**Designation:** Assistant Professor of Biochemistry

**Qualification:** PhD (Indian Institute of Technology Delhi)

**Research Area:** Protein Biochemistry, Aggregation and Folding Studies, Adsorption Chemistry



**Dr. Debasree Ghosh**

**Designation:** Assistant Professor of Biochemistry

**Qualification:** PhD (CSIR-Indian Institute of Chemical Biology, Kolkata)

**Research Area:** Nanobiotechnology, Cancer Biology



**Dr. Manish Shandilya**

**Designation:** Assistant Professor of Biochemistry

**Qualification:** PhD (University of Delhi)

**Research Area:** Protein Engineering, Bio-physical Studies (Metal Proteins)



**Dr. Rakesh Kumar**

**Designation:** Teaching Associate of Chemistry

**Qualification:** Ms Interdisciplinary Studies

Ms Chemistry from The University of Montana, USA

**Research Area:** Organometallic Catalysis & Medicinal Chemistry



## FACULTY PROFILE



**Mr. Ravi Rath**

Teaching Associate of Forensic Sciences

**Qualification:** M.Sc Forensic Science,  
Amity University, Noida, Pursuing PhD

**Research Area:** Forensic Chemistry and Toxicology, Forensic  
Ballistics, Forensic Anthropology

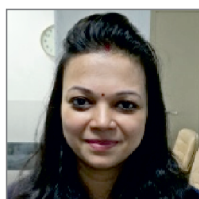


**Dr. Bhuvnesh Yadav**

**Designation:** Assistant Professor of Forensic Sciences

**Qualification:** PhD (AIIMS, New Delhi)

**Research Area:** Forensic Biology, DNA Fingerprinting,  
Gene Diversity



**Dr. Richa Rohatgi**

**Designation:** Assistant Professor of Forensic Sciences

**Qualification:** PhD (University of Delhi)

**Research Area:** Fingerprinting, Forensic Physics, Forensic  
Ballistics, Questioned Documents, Forensic Toxicology



**Dr. Dipti Vaya**

**Designation:** Associate Professor of Chemistry

**Qualification:** PhD (MLSU Rajasthan)

**Research Area:** Photocatalysis, Nanotechnology



**Dr. Pooja Rawat**

**Designation:** Assistant Professor of Chemistry

**Qualification:** PhD (University of Delhi)

**Research Area:** Material Chemistry, Photocatalysis, Phosphors



**Dr. Monu Verma**

**Designation:** Assistant Professor of Chemistry

**Qualification:** PhD (IIT Roorkee)

**Research Area:** Nanotechnology, Waste Water Treatment,  
Decontamination, Environmental Engineering,  
Photocatalytic Activity



**Dr. Varun Rawat**

**Designation:** Assistant Professor of Chemistry

**Qualification:** PhD (CSIR-national Chemical Laboratory, Pune)

**Research Area:** Development of New Synthetic Methods,  
Synthesis of Bioactive Molecules, Synthesis and Application of  
Calixarene Based Chemosensors and Catalyst



**Dr. Gyaneswar K. Rao**

**Designation:** Assistant Professor of Chemistry

**Qualification:** PhD (IIT Delhi)

**Post Doc:** University of Ottawa, Canada

**Research Area:** Environmental Chemistry, Catalyst Design,  
Electro- and Photo-catalysis, Small Molecule Activation

## LAB ASSISTANTS AND ATTENDANTS



*From left to right:*

**Mr. Pawan**  
Lab Attendant

**Mr. Dharmendar**  
Lab Assistant

**Mr. Vijay Kumar**  
Lab Assistant

**Mr. Kuldeep**  
Lab Assistant

**Ms. Sheela**  
Lab Attendant

## RESEARCH SCHOLARS

S.No.	Name of Candidate	Date of Registration	Name of Supervisor
1.	Simpi Mehta (Degree Awarded)	2013	Prof. Seema R Pathak
2.	Rakesh Kumar (Degree Awarded)	2014	
3.	Manisha Mann	2015	
4.	Ravi Rath	2017	
5.	Ritika	2018	
6.	Poonam Kaswan (NET-LS)	2018	
7.	Praveen Kumar (NET-JRF)	2018	
8.	Nirmla Devi Degree Awarded	2014	Prof. Joydeep Dutta
9.	Sudeshna Dasgupta	2015	
10.	Mousumi Saikia	2015	
11.	Priyanka	2016	
12.	Gaurav Kumar Bharadwaz	2016	
13.	Rajesh	2016	
14.	Meena Singh (NCU, Gurugram)	2012	Dr. Dipti Vaya
15.	Renu Yadav (NCU, Gurugram)	2017	
16.	Nidhi Verma (NCU, Gurugram)	2017	
17.	Deepak Kumar	2018	
18.	Manisha Sharma	2015	Dr. Sudip Majumder
19.	Pratibha Sharma	2016	
20.	Sujata	2017	
21.	Sameer	2016	Dr. Bhuvnesh Yadav
22.	Birajpal Singh	2016	Dr. Anurag Sharma
23.	Ishfaq Ahamd Ahanger	2016	
24.	Pooja	2017	Dr. Monika Vats
25.	Rinkal Chaudhary	2018	Dr. Richa Rohatgi
26.	Anshu Kumar Sinha	2018	Dr. Varun Rawat

## PLACEMENTS

Name	Program	Batch	Company Name
Vaishnavi	M.Sc. AC	2012-14	Panacea, Biotech
Naveen Rawat	M.Sc. AC	2012-14	Tribocare FZC, Sharjah
Rajguru	M.Sc. AC	2012-14	Siegwerk
Jatin	M.Sc. AC	2012-14	Siegwerk
Mukesh Didwaniya	M.Sc. AC	2013-15	Panacea, Biotech
Lakshmi Kundu	M.Sc. AC	2013-15	Siegwerk
Priyanka Baweja	M.Sc. AC	2013-15	Siegwerk
Niti Varshney	M.Sc. AC	2014-16	Dhanuka Labs
Sangeetha	M.Sc. AC	2014-16	Atotech India Pvt Ltd
Sumit	M.Sc. AC	2014-16	Atotech India Pvt Ltd
Shakshi	M.Sc. AC	2014-16	Atotech India Pvt Ltd
Baljeet singh Yadav	B.Sc. (H) Chem	2014-17	Geetanjali Homestate Pvt Ltd
Neha Sharma	M.Sc. FS	2014-16	Ph.D from Delhi University
Meena Jha	M.Sc. FS	2015-17	M3M Reality
Pooja Singh	M.Sc. FS	2015-17	M3M Reality
Pawan Maithil	M.Sc. AC	2015-17	Avitech, Indian Oil
Pankaj	M.Sc. AC	2015-17	AuroNext
YashVeer	M.Sc. AC	2015-17	AuroNext
Shaily	M.Sc. AC	2015-17	Oriental Carbon and Chemical Ltd, Dharuhera
Priyanka Raghav	M.Sc. AC	2015-17	Loreal Organics
Kritika Nagpal	M.Sc. AC	2015-17	Textile Institute of Technology, Jaipur
Payal Mendirata	M.Sc. AC	2015-17	Green wood Public School, PGT
Ipsa Soodan	B.Sc. FS	2014-17	Emtex Engineering
Parvinder Vashishth	M.Sc. AC	2015-17	Mankind Research Centre(MRC)
Bawana	M.Sc. AC	2015-17	United Breweries
Meena Jha	M.Sc. FS	2015-17	Brij Tech Services, Noida
Barkha Yadav	M.Sc. FS	2015-17	Modi University, Rajsthan
Anshu	MSc- Bio-Chem	2015-17	Oncquest Laboratory New Delhi
Mallikarjun	MSc- Bio-Chem	2016-18	Decathlon, Water Sports Sports Leader
Swati Srivastava	MSc- Bio-Chem	2016-18	Decathlon, Apelo Consulting Pvt. Ltd
Apoorva Bhadauria	M.Sc. FS	2016-18	Decathlon, Mountain Sports Sports Leader
Jessyka Kashyap	B.Sc. FS	2015-18	Amazon India Pvt. Ltd.
Sandhya Sharma	M.Sc. AC	2016-18	Siegwerk India Private Limited
Sanjeet Kumar Prasad	MSc- Bio-Chem	2016-18	Growmans Research Group
Ayushi Bidhat	MSc- Bio-Chem	2016-18	Growmans Research Group
Tanvi Sharma	M.Sc. AC	2016-18	Atotech India Pvt Ltd6
Jaiya Shakya	M.Sc. AC	2016-18	Atotech India Pvt Ltd
Sarita Sharma	M.Sc. AC	2016-18	Atotech India Pvt Ltd
Anjana Ghosh	M.Sc. AC	2016-18	Atotech India Pvt Ltd
Sachin Jalwal	M.Sc. AC	2016-18	Atotech India Pvt Ltd
Praveen Thakur	M.Sc. AC	2016-18	Mankind Pharma Ltd
Neeraj Rao	M.Sc. AC	2014-16	Asian paints
Mamta Yadav	M.Sc. AC	2014-16	PGT
Praveen Kumar	M.Sc. AC	2014-16	PGT
Vinta Yadav	M.Sc. AC	2014-16	Space Technologies Ltd.
Anuj Thakral	M.Sc. AC	2015-17	Ph.D from CSIR-NPL

## EVENTS ORGANIZED

### Contemporary Research Endeavors” A Seminar Series



Dr. Peter Langer, Leibniz Institute of Catalysis, University of Rostock, Germany

CIM Global, Indian Representative of the American Chemical Society the world's largest scientific society and one of the leading sources of authoritative scientific information conducted an ACS interactive talk with students and faculties related to the field of chemistry in order to make them aware of the presence of American Chemical Society in India & enjoy the benefits of what the society offers.

### Seminar and interactive session on GRE & TOEFL



A seminar on GRE & TOEFL was held on 07/04/2015 organized by Department of Chemistry, Amity School of Applied Science, Amity University Haryana.

Ms Garima Masand, program manager of Learning Link Foundation India addressed the post graduate students of ASAS, AUH about the procedure and essentials for appearing in GRE & TOEFL exams.

### INSPIRE

Innovation in Science Pursuit for Inspired Research and School Connect Inspire is an initiative of Department of Science and Technology (DST), Government of India. As many as 334 students from different schools of Delhi and Gurgaon participated in the event. The INSPIRE participants were also brought to Chemistry/ Biochemistry/ Forensic labs of Amity University for lab demonstrations.





### Visit to Oncquest Laboratory

The visit was facilitated by Oncquest Laboratory on 10th February 2017 for the students pursuing Masters in Biochemistry, Chemistry & Forensic Science. The students were accompanied by faculty, Dr. Sudip, Dr. Anurag, Dr. M. Nidhin, and Dr. Bhuvnesh. The objective was to make students understand about various tools and techniques required to test clinical specimens in order to obtain information about the health of a patient pertaining to the diagnosis, treatment and prevention of disease. The students were also briefed about the importance of genome – based laboratory testing and the methods involved in it.



## SPECIAL TALKS

**Title of Talk:** Medicolegal and Pathological Aspects of Autopsy

**Speaker:** Dr. Ranjeet Kumar, Assistant Professor, AFMC



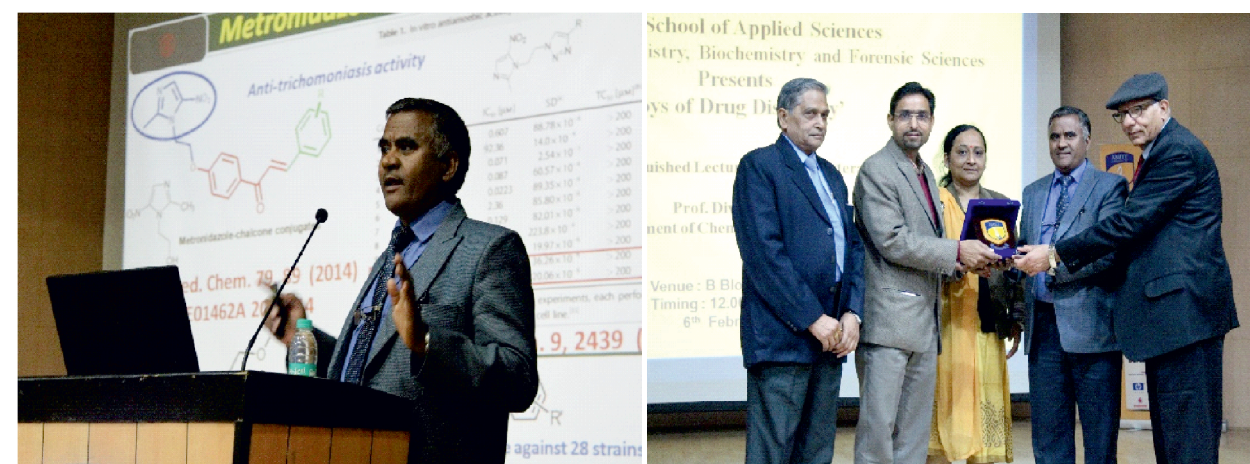
The lecture was organized to enhance the knowledge of the students about Forensic Medicine, methods and technique used in post-mortem.

The practical aspects of autopsy and its correlation with causes and time since death will be discussed in the subsequent visit of students and faculty to the Department of Forensic Medicine and Toxicology in AIIMS, New Delhi.

## INVITED LECTURE & FACULTY INTERACTION

**Title of Talk:** Joy of Drug Discovery !!

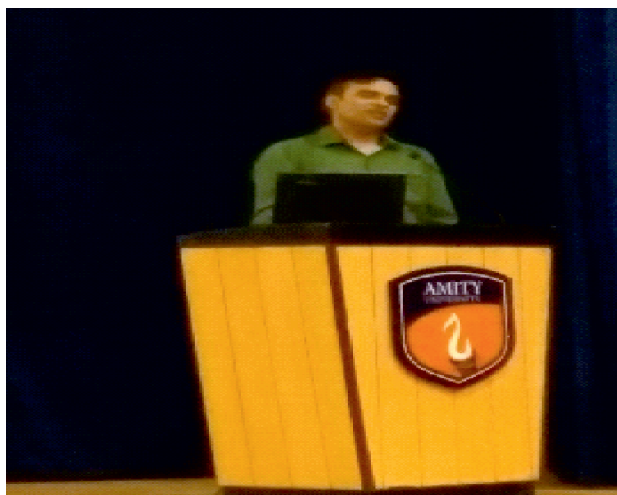
**Speaker:** Prof. D S Rawat, Department of Chemistry, University of Delhi





**Title of Talk:** Neuroreceptor Quantification - a need of PET Radio-chemistry in Current Scenario

**Speaker:** Dr. Anjani Kumar Tiwari, Department of Chemistry, BBAU Central University, Lucknow



**Title of Talk:** Computational Biophysical Studies on CRISPR/Cas9

**Speaker:** Dr. Angana Ray, Post Doctoral Researcher at University of Southern California, USA



**Title of Talk:** Thrust Areas in Forensic Research

**Speaker:** Prof. (Dr.) S. K. Shukla, Director, Amity Institute of Forensic Sciences, Amity University, Noida



## STUDENTS ACHIEVEMENTS

S. No.	Student Name	Subject	Achievements	Place	Date
1	ARUNIMA DUTTA	BSc (H) FS	Won <b>First Prize</b> in Poster Presentation in 39 <sup>th</sup> Annual Conference MEDICON-2018.	JIPMER, Puducherry	1-3 Feb 2018
2	SOHINI SENGUPTA	BSc (H) FS	Won <b>Second Prize</b> in Poster Presentation in 39 <sup>th</sup> Annual Conference MEDICON-2018.	JIPMER, Puducherry	1-3 Feb 2018
3	VIBHANSHU DAVORIA	MSc (FS)	Won <b>Third Prize</b> for a National level competition Anveshan	Manav Rachna International Institute of Research and Studies, Faridabad	2018

### Publication by students

- Ms. Pratibha Sharma, Postgraduate student, published a review article "Heavy Metal Removal from Industrial Wastewater Using Fungi: Uptake Mechanism and Biochemical Aspects" in Journal of Environmental Engineering in 2015 under the guidance of Dr. Arun Kumar.
- Mr. Himanshu Yadav & Ms. Neetu Yadav, Postgraduate student, published a research article "Structural & Functional aspects of Trypsin-Gold Nanoparticle Interactions: An Experimental Investigation" in Material science & Engineering B in 2015 under the Guidance of Dr. Sudip Majumder & Dr. M. Nidhin.
- Ms. Priyanka Yadav, Postgraduate student, published a research article "Green Synthesis of Silver Nanoparticles Using Leaf Extract of Helianthus annuus & Menthalongifolia and Screening of their Antimicrobial Activity Against Escherichia coli" in Nanoscience& Nanotechnology Asia in 2016 under the Guidance of Dr. Sudip Majumder.
- Ms. Shikha Dhiman, Postgraduate student, published a research article "Transition metal oxide nanoparticles are effective in inhibiting lung cancer cell survival in the hypoxic tumor microenvironment" in Chemico Biological Interaction, in 2016 under the Guidance of Dr. Sudip Majumder.
- Ms. Neha Sharma, Postgraduate student qualified Joint CSIR-UGC National Eligibility Test in Chemical Sciences in 2016.
- Mr. Anuj Thakral, Postgraduate student, qualified Joint CSIR-UGC National Eligibility Test in Chemical Sciences in 2018, GATE-2017.
- Ms. Shilpa Sharma, Postgraduate student, qualified Joint CSIR-UGC National Eligibility Test in Chemical Sciences in 2018.



## ACTIVITIES



## NATIONAL COLLABORATIONS FOR TRAINING & RESEARCH



## INTERNATIONAL COLLABORATIONS FOR RESEARCH



### EDITORS

Prof. A. K. Yadav  
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Prof. Seema R. Pathak  
(HOD, CBFS)  
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Chemistry  
Dr. Bhuvnesh Yadav,  
Forensic Science  
Dr. Pooja Rawat,  
Chemistry  
Dr. Varun Rawat,  
Chemistry  
Dr. Anurag Sharma,  
Biochemistry

### REVIEWERS

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Dr. Dipti Vaya,  
Chemistry  
Mrs. Shipra Rohtagi,  
Forensic Science  
Dr. Monika Vats,  
Chemistry  
Dr. Richa Rohatgi,  
Forensic Science

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Dr. Monu Verma,  
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Mr. Rakesh Kumar,  
Chemistry  
Mr. Ravi Rathi,  
Forensic Science  
Dr. Chandra Mohan  
Srivastava  
Dr. Nidhin, Christ  
University, Bangalore