



**DEPARTMENT OF  
DYESTUFF  
TECHNOLOGY**

## ABOUT THE DEPARTMENT



### PROFESSOR G. S. SHANKARLING

*B. Sc. (Hon), B. Sc (Tech), M. Sc. (Tech), Ph.D. (Tech).*

Professor of Dyestuff Technology

Head of the Department

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The Department of Dyestuff Technology was established in 1944 under the stewardship of Prof. K. Venkataraman, the then director of Institute of Chemical Technology (ICT, then known as UDCT), University of Mumbai. Under the successive leadership of highly experienced, talented and hard-working scientists and scholars the department has trained more than 1200 undergraduate students and over 550 postgraduate students. The thrust area of this department is the development of organic chemical technologies, including dyestuff and intermediates, specialty and fine chemicals, agrochemicals, perfumery and flavor chemicals and process intensification in the above fields.

The department is a unique center of learning that offers an advanced curriculum in tune with the latest industrial and academic developments. The B. Tech course in Dyestuff

Technology emphasizes the process chemistry, technology and engineering of organic intermediates and colorants. In the last few academic years, the department placed all graduating students in the chemical industry in various fields such as R & D, production, marketing, etc. A large number of students secured admissions along with financial aid in reputed universities across the globe. Thanks to generous financial support from Colourtex Pvt. Ltd, the department has initiated a major renovation of the undergraduate laboratory.

A strong research focus in the area of functional colorants has enabled the department to file over 20 patents in the last two years and publish over 150 papers in international journals in the past five years. Recruitment of three young faculty members in the last two years under the auspices of the UGC Faculty Recharge Programme has finally ended a severe faculty crunch the department dealt with for more than a decade. The department tries to maintain close ties with the Indian dyestuff and chemical industry by way

of organizing conferences, seminar and guest lectures. These activities not only bridge the gap between industries and academia it provides undergraduate students an excellent opportunity to interact with the industry.

The Department of Dyestuff Technology organizes conferences, seminar and guest lectures' every year in order to bridge the gap between industries and the academia. The objective of arranging such co-curricular activities enhances the exposure of the dyes and dyestuff manufacturing community to undergraduate and graduate students.

Dyes Department jointly organizes the International conference- "Convention on Colorants (COC)" biannually with DMAI (Dyestuff Manufacturers Association of India). The aim of the convention is to enhance cooperation between industry and academia. In the past eight years four such conferences were organized namely COC 2011, COC 2013, COC 2015, COC 2017.

In 2016, the department has

started with a new concept of having an international symposium on ionic liquids to propagate a greener aspect of the chemistry to the world. On 21st and 22nd January 2016, the department had organized the International Symposium on Ionic Liquids (ISOIL 2016) in collaboration with Reliance Industries Ltd. The focus was given on industrial applications of ionic liquids.

Apart from these technical events the department has been organizing “Dyes Day” since 2013, where all dyes alumni get chance to meet and have informal and formal discussions with each other. A panel discussion is organized where dyes alumni from industry share their experiences and help undergraduates to understand the current market status of dyes and chemical industries. The event ends with a cultural program where the students, faculty and alumni showcase

their talent.

Along with this Department also organizes Memorial lecture series as a tribute to legends of department that includes K.V. Venkatraman lecture series, Kabbur Memorial lecture, Dr. KKG Menon lectures amongst others

### **VISION 2020**

“To build world class programmes of excellence in education and research in specialized areas of Dyestuff, Chemistry and Technology for the benefit of society through problem solving competencies”

### **MISSION**

The Department aspires to be one of the world’s top ten colour chemistry departments by 2020. It will do so by:

Providing knowledge and skill based training at the undergraduate level by designing, teaching and

periodically upgrading a colour chemistry and technology syllabus in line with current and anticipated trends in industry and academia.

Pursuing world-class research in the colourants and related areas – basic textile and leather coloration, functional colourants, organic process technology and specialty chemicals.

Proactively developing and maintaining close interaction with national and international research laboratories, universities and chemical industries

### **PROGRAMS OFFERED:**

1. B.Tech (Dyes)
2. M.Tech (Dyes)
3. M.Tech (Perfumery and Flavour Technology)
4. M.Tech (Green Technology)
5. Ph.D (Tech)
6. Ph.D (Sci)

# FACULTY



## PROFESSOR G. S. SHANKARLING

*B. Sc. (Hon), B. Sc (Tech), M. Sc. (Tech), Ph.D. (Tech).*

Professor of Dyestuff Technology

Head of the Department

### SUBJECTS TAUGHT DURING 2016-17 :

#### B. Tech

- DYT-1531 Chemistry and technology of speciality organic Intermediates and fine chemicals
- DYT-1601 Chemistry and technology of reactive, vat and cationic dyes
- DYT-1701 Chemistry of functional dyes
- DYT-1812 Introduction to green chemistry

#### M. Tech

- DYT-2001 Chemistry of functional colorants
- PFT-2001-Chemistry of perfumes and Flavours
- DYT-2802 Chemistry and technology of agro chemicals
- GTT 2104- Analysis and development of green Industrial process

#### RESEARCH INTERESTS:

Green Chemistry, Perfumary and Flavour Technology, Functional colorants, Supramolecular Chemistry, Metal-ion fluorescent sensor, Ultrasonics sonochemistry and Computa-

tional studies.

**PUBLICAITONS (PEER  
REVIEWED) SO FAR: 94**

**PATENTS: 19**

**CONFERENCE  
PROCEEDINGS/PAPERS: 71**

**SEMINARS/LECTURES/  
ORATIONS DELIVERED: 31**

**PH.D.'S AWARDED AS  
SINGLE: 14**

**MASTERS AWARDED AS  
SINGLE: 29**

**H-INDEX: 17**

**CITATIONS: 1355**

**RESEARCH STUDENTS:**

- Ph.D. (Sci) in Chemistry-13
- Ph.D. (Tech.) in Dyestuff Technology- 02
- Ph.D. (Tech.) in Green Technology- 02
- M. Tech in Dyes. - 02
- M. Tech in Green Technology- 02
- M. Tech in Perfumery- 02

**RESEARCH PUBLICATIONS  
FOR CURRENT YEAR: - 17**

Conference proceeding- 71  
Book Chapter- 01

**PATENTS: 19**

**SPONSORED PROJECTS:**

Completed - 10

Ongoing - 06

### PROFESSIONAL ACTIVITIES (MEMBERSHIP OF IMPORTANT COMMITTEES):

- Administrative Co-coordinator for Perfumery and Flavors Course.
- Placement coordinator of Perfumery and flavors
- Member of Editorial board for Bombay Technologist
- Member Technological Association
- Life member UDCT Alumni Association
- Teqip Departmental coordinator
- Teqip in charge of student training programme
- Member, Board of governors,SVIMS
- Examiner for Ph.D. Thesis in Sardar Patel University, Gujarat.
- Member of ICT Handbook committee.
- Member of ICT Annual Report.
- Member of ICT Diary

- student and faculty
- xiii. Member of Exam Committee
  - xiv. Member of IChE

### SPECIAL AWARDS/ HONOURS / ACCOLADES TO STUDENTS:

- (i) Mr. Pravin Borase received third prize for the oral presentation in NSFAC-2016.
- (ii) Mr. Balu Gadilohar received third prize for the oral presentation in CATSCOL-2016, Mumbai.
- (iii) Mr. Eknath Gayakwad awarded with Shri G.M. Abhyankar Students' Travel Assistance Award in the year 2016
- (iv) Mr. Mekonnen Habtemicheal was awarded first prize for the poster presentation in COC-2017
- (v) Mr. Pravin Borase received third prize for the poster presentation in COC-2017.

### HIGHLIGHTS OF RESEARCH WORK DONE AND IT'S IMPORTANCE:

- (vi) Functional colorants: Thermo-chromic and Photo-chromic dyes, Metal sensors, Chemosensor for anions, Studies in Supramolecular

Chemistry (macromolecules), Dye Sensitized solar cell (DSSC), Non-Linear Optics (NLO) etc.

- (vii) Dyes and pigments: High-performance pigment, Synthesis of colorant dyes.
- (viii) Green chemistry: Catalytic system using enzyme for various Organic reaction, Preparation and application of ionic liquids for organic synthesis, Green chemistry and Technology mainly development of environmentally benign organic synthesis.
- (ix) Process chemistry: Ultrasonic Sonochemistry, process intensification for development of azo dyes, Studies in oxidation reactions.

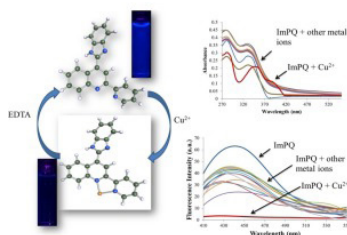


Fig A. 2-pyridyl quinoline based chemosensor with visible colour change for detection of  $\text{Cu}^{2+}$  ions

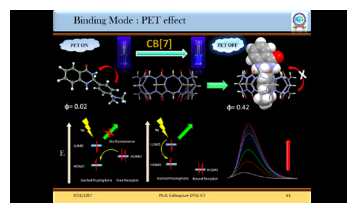


Fig.B. Supramolecular interactions between CB7 and receptor DQZ

In the recent past we have developed some selective protocols like A thiazoloquinoxaline based “turn-on” chemodosimeter for detection of copper ions. We have developed some green methodology for the halogenations of commercially important deactivated aminoanthracene-9,10-diones which are very helpful in dyestuff industry. Other research areas include use of Deep Eutectic Solvent as a green media for the various organic transformations. We are also working on synthesis of pigment using green media like DES as a solvent



### PROFESSOR N. SEKAR

*B.Sc. (Hon), B.Sc. (Tech), M.Sc. (Chemistry) Ph.D. (Tech), B. A (Music), M.A (German), M.Mus. (Indian Music)*

Professor of Dyestuff Technology

#### RESEARCH INTERESTS :

Synthesis of multistep Heterocyclic and Fused Heterocyclic compounds, Process development of intermediates, Fluorescent compounds for bio-sensors, medical diagnostics and security strong disperse dyes sensing, Laser Dyes, NIR absorbing, fluorescing and reflecting colorants, Tinctorially, Extended Styryl dyes, Metal complex dyes for photovoltaics, Greener Methods for fluorescent compounds, Synthesis and formulation of perfumes and flavors, Computational Chemistry.

**PUBLICATIONS (PEER REVIEWED) SO FAR:** 374

**PATENTS:** 07 FILED

**CONFERENCE PROCEEDINGS/PAPERS:** 115

**SEMINARS/LECTURES/ ORATIONS DELIVERED:** 26

**PH.D.'S AWARDED AS SINGLE:** 15

**MASTERS AWARDED AS**

**SINGLE/ CO-GUIDE:** 22

**H-INDEX:** 16

**CITATIONS:** 197

**RESEARCH STUDENTS:**

PDF - 01

Ph.D. (Tech.) - 01

Ph.D. (Sci) -31

M. Tech. - 2

**RESEARCH PUBLICATIONS:**

International- 20

Peer-reviewed - 20

Conference proceeding- 25

Books- 02

**PATENTS:**

Indian - 07 filed

**SPONSORED PROJECTS:**

Government- 06

Private- 01

**SPECIAL AWARDS/ HONOURS / ACCOLADES:**

1. Awarded as Chairperson at the International conference on Pure and Applied chemistry held in Mauritius in July 2016.
2. Certified as Invited speaker in 35th Annual National Conference

of Indian Council of Chemists held at Haribhai V.Desai collage,Pune in association with collage of Engineering,Pune in December 2016.

#### HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPACT:

The present research activities include synthesis of multistep heterocyclic fluorescent compounds for biosensor, medicinal diagnostics and sensor for security applications. Process development of commercially important intermediates. The synthesis involves molecular design of fused heterocyclic compounds with the features of extended Styryl system giving NIR absorption and Fluorescence. We are also working on synthesis of nanomaterials for high-tech application and dyes for solar cell. Working on greener methods for heterocyclic systems, perfumes and flavors technology. Computational study for synthesized molecules.



**PROFESSOR P.M.BHATE**

*B.Sc. (Hons), B.Sc. (Tech.), Ph.D.*  
Professor of Dyestuff Technology

**RESEARCH INTERESTS :**

Carbohydrate chemistry, Colour chemistry

**PUBLICATIONS (PEER REVIEWED) SO FAR: 11**

**PATENTS: 02 APPLIED**

**CONFERENCE**

**PROCEEDINGS/PAPERS: 09**

**SEMINARS/LECTURES/ ORATIONS DELIVERED: 14**

**PH.D.'S AWARDED AS SINGLE: 02**

**MASTERS AWARDED AS SINGLE/ CO-GUIDE:03**

**H-INDEX: 4**

**CITATIONS: 124**

**RESEARCH STUDENTS:**

Ph.D. (Sci) -05

M. Tech. - 0

**RESEARCH PUBLICATIONS:**

Peer-reviewed - 03

**HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPART:**

We have gathered conclusive evidence that cellulose-dye covalent bond is formed when an aryl diazonium salt prepared from a dyestuff having a primary aromatic amino group is allowed to react with cellulose under the usual dyeing condi-

tions. Since a primary aromatic amino group is present in an overwhelming majority of commercial azo dyes, all such azo dyes, in principle, can now become reactive dyes by application of our methodology. We have shown that ninhydrin undergoes an unprecedented condensation reaction with various 2-aminobenzamide derivatives in boiling water to afford 11a-hydroxy-11,11a-dihydrobenzo-[e]indeno[2,1-b][1,4]diazepine-10,12-dione derivatives. These hitherto unreported products are easily isolated in high yield by a simple filtration step.



**DR. SURAJIT SOME**

*Ph.D. (IIT KGP)*  
UGC-Assistant Professor of Dyestuff Technology

**SUBJECTS TAUGHT DURING 2016-17:**

Chemistry of Heterocycles, Colour Chemistry-An Introduction, Use of Analytical Instruments in Synthetic Organic Chemistry, Chemistry and Technology of Benzene Intermediates-I, Mechanism of

Organic Reactions, Statistical Design of Experiments, Analysis of Intermediates, Dyes and Fibers, Analysis of Inorganic Raw Materials, Experimental Dyeing.

**RESEARCH INTERESTS :**

Graphene Nanotechnology

**PUBLICATIONS (PEER REVIEWED) SO FAR: 28**

**PATENTS: 08**

**H-INDEX: 18**

**CITATIONS: 1085**

**RESEARCH STUDENTS:**

**PH.D. (SCI)- 03**

## RESEARCH PUBLICATIONS:

International- 01

## PATENTS:

International- 1

Indian- 2

## SPONSORED PROJECTS:

Government- 03

## PROFESSIONAL ACTIVITIES (MEMBERSHIP OF IMPORTANT COMMITTEES):

American Chemical Society Member

## SPECIAL AWARDS/HONOURS / ACCOLADES:

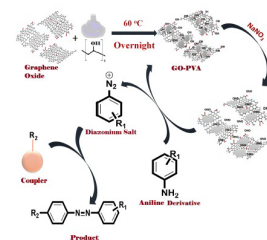
DST Project sanctioned of 25.81 Lacs

## HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPACT:

An efficient and a simple ap-

proach for the synthesis of azo dyes have been developed by the diazo coupling reactions of active aromatic compounds in the presence of in-situ nitrite functionalized graphene oxide polyvinyl alcohol GO-PVA composite as a highly efficient nitrosonium ion source. This methodology was objected to defeat the limitations of the earlier reported method such as use of acids, alkalis and toxic solvents, to reduce the stability of diazonium salts at room temperature, modest yields and long reaction time. Additionally, the attractive advantages of the process are that it incorporated mild conditions with excellent yield, simple product isolation process, fastest reaction time and recyclabil-

ity of catalyst. The isolated products were characterized by FT-IR spectrum, UV-spectroscopy and  $^1\text{H-NMR}$ . The as-prepared composites were confirmed by UV-Visible, XRD, XPS, FT-IR spectrum, SEM and TGA analysis.



Scheme 1. Nitrite functionalized GO-PVA as highly efficient Nitrosonium source and catalyst for synthesis of azo dye.

Scheme 1 : Nitrite functionalized GO-PVA as highly efficient Nitrosonium source & catalyst for synthesis of azo dye.



### DR. SATYAJIT SAHA

Ph.D. (IITK)

UGC-Assistant Professor of Dyestuff Technology

## SUBJECTS TAUGHT DURING 2016-17:

- Chemistry and Technology of Acid, Direct and Sulfur Dyes
- Chemistry and Technology of Pigments
- Preparation of Dyes
- Preparation of Intermediates
- Preparation and Analysis of Dyes, Intermediates, Optical

Brighteners, Functional Colorants

- Elective-Chemistry of Agrochemicals
- Elective-Green Chemistry

## RESEARCH INTERESTS:

- Organic Synthesis towards the synthesis of functional molecules, Green Chemistry, Catalysis, Asymmetric

Organocatalysis, DSSC, Mechanistic Organic Chemistry

PUBLICATIONS (PEER REVIEWED) SO FAR:13

CONFERENCE PROCEEDINGS/PAPERS: 03

SEMINARS/LECTURES/ ORATIONS DELIVERED: 02

H-INDEX: 09



CITATIONS: 430

#### RESEARCH STUDENTS:

P.D.E./RA- 1 (post doc)

Ph.D.(Sc)- 1(SRF)

Others (BTUGRP)- 1

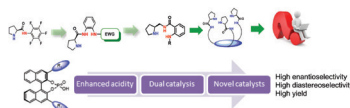
#### RESEARCH PUBLICATIONS:

International- 02

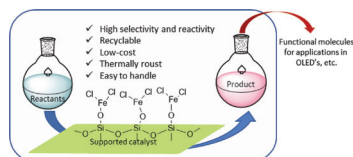
#### HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPACT:

The central theme of my research activities is synthetic organic chemistry, green chemistry, with a special focus on the design and development of novel catalysts and their application towards stereoselective synthesis both for the control of relative and absolute configuration as well as designing functional organic molecules for applications in DSSC, OLED's etc. The construction of complex molecular architectures, especially those with multiple stereogenic carbon atoms from simple chemicals, continues to be a resourceful effort in both academic and industrial domains. The challenge is intensified further when need to perform the reactions in an atom economical and non-hazardous way. Our research is aimed at designing novel catalysts (both organo- and metal based) with diverse chemical motifs which may have roles not only in catalytic activation but also in the orchestration or organization of the reacting components via

supra molecular interactions. Structurally and functionally multifaceted organocatalysts may find new roles in organized catalysis for deeper access into chemical reaction space. Here the below scheme depicts the rational modification of catalysts structures and the hunt is on for a better catalyst.



Another aspect of our research is the application of solid supported catalysts in various organic transformations in a greener and cleaner way. The solid supported catalysts have received considerable importance in organic synthesis because of their ease of handling, enhanced reaction rates, greater selectivity, simple workup, low-cost, and recoverability and recyclability of catalysts. This catalyst can act as eco-friendly for a variety of organic transformations, non-volatile, recyclable, non-explosive, easy to handle, and thermally robust.



Another facet of our research interest is design and synthesis of organic materials for Dye Sensitized Solar Cell (DSSC). Incessant growth of human

population and improved living standards has resulted in a steep rise in world's energy consumption. Therefore, there is a rapid depletion of earth's fuel resources. This has directed the global scientific community to explore renewable energy resources, realizing solar energy as a much cheaper and efficient alternative. Organic Dye-sensitized solar cells (DSSCs) are identified as one such efficient converter of solar energy to electricity and are recognized as a novel substitution of the conventional silicon based solar cells due to its low-cost material, ease of fabrication and reasonable good power conversion efficiency. Although the scientific community has evidenced a quantum jump in the research related to organic DSSC in recent years, the cell efficiency and performance are still not at par with the metal complex based DSSC. It demands a more comprehensive understanding on the structure-property relation of the organic dyes wrt solar radiation absorption. Therefore, there is a relentless effort in fine-tuning the chemical structures of donors and acceptors of the dye molecules for improving efficiency and cell performance.



## DR. NABANITA SADHUKHAN

Ph.D. (IIT KGP)

UGC-Assistant Professor of Dyestuff Technology

### RESEARCH INTERESTS:

Inorganic Chemistry, Biologically important small molecules, Monodisperse polymer, Light responsive functional molecule.

### PUBLICATIONS (PEER REVIEWED) SO FAR : 17

### CONFERENCE PROCEEDINGS/PAPERS: 2

### SEMINARS/LECTURES/ ORATIONS DELIVERED: 6

### MASTERS AWARDED AS SINGLE: 2

H-INDEX: 08  
CITATIONS: 230

### NUMBER OF SPONSORED PROJECTS:

Government- 2

### PROFESSIONAL ACTIVITIES (MEMBERSHIP OF IMPORTANT COMMITTEES):

Member of American Chemical Society

Project Title:

Synthesis and characterization of photo and thermo dual responsive amphiphiles for the biological application

Abstract: A polyethylene glycol (PEG) bolaamphiphile containing azobenzene as

a photoresponsive unit was prepared. PEG-bolaamphiphile was characterized by 1D <sup>1</sup>H, <sup>13</sup>C, and 1H-<sup>13</sup>C HSQC, HMBC Nuclear Magnetic Resonance (NMR) Spectroscopy, Electro spray Ionization Mass spectrometry Techniques. PEG-bolaamphiphile afforded a photo-responsive organogel, when dissolved in aromatic solvent. Critical gelation concentration (CGC) was established. The 'gel-to-sol' transition temperature (T<sub>gel</sub>) of the gel was obtained by the "inverse flow method" and Differential scanning calorimetry (DSC). The gel was characterized by variable concentration <sup>1</sup>H NMR spectroscopy. Optical microscopy technique was conducted to visualize microscopic morphology of the gel matrix. The stimuli-responsive property of the organogel was explored by UV-visible spectroscopy and fluorescence spectroscopy upon UV-irradiation at different time interval and at variable temperature. Efforts towards potential applications of the PEG-organogel for the encapsulation and controlled delivery of biomolecules are

currently underway in the laboratory.

### Project summary:

- Synthesis and characterization of PEG-bolaamphiphile: I have successfully synthesized a monodispersed, discrete, pure short PEG-bolaamphiphile functionalized with azobenzene residue by following systematic organic synthetic procedure. The compound was primarily characterized using <sup>1</sup>H, <sup>13</sup>C and HMQC and HSQC Nuclear Magnetic Resonance (NMR), Electron Spray Ionization (ESI) – Mass Spectroscopy techniques.
- Gelation property of PEG-bolaamphiphile: The gelation ability of PEG-bolaamphiphile was systematically studied in different solvents including polar protic, polar aprotic and nonpolar solvents by cooling the isotropic hot solution (~ 60 °C) of PEG-bolaamphiphile to room temperature (26 °C). This process yielded gel matrix in aromatic solvents within 10 to 15 min only. Presumably, incorporation of azobenzene

functional group into the low-molecular-weight PEG-chain modulated its self-assembly process in organic solvent leading to the formation supramolecular organogel. The gelation state of the material in presence of aromatic solvent was confirmed by the “stable-to-inversion” method, which did not show gravitational flow upon turning the vial upside down (Figure 1).

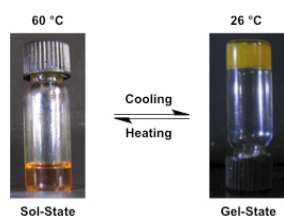


Figure 1. Representative micrograph of sol-to-gel formation of PEG-bolaamphiphile.

The critical gelation concentration value was obtained as 1% w/v (1 g of solute per 100 mL solution). The gel-to-sol transition temperature (Tgel) of the gel was obtained by the “inverse flow method” and further confirmed by the Differential scanning calorimetry (DSC). The Tgel measured by “inverse flow method” correlated well to the corresponding endothermic transition observed by DSC result. Moreover, it is observed that the Tgel increased considerably (10 °C) with increasing initial gelator concentration indicating that gel formation is driven by intermolecular

non-covalent interactions. Optical microscopy technique was conducted to visualize microscopic morphology of the gel matrix. Micrograph obtained from optical microscopy revealed characteristic entangled fibrillar network of PEG-bolaamphiphile in presence of aromatic solvent (Figure 2). Optical micrograph of PEG-organogel indicated that the fibers that are present in the organogel possess uniform diameter ranging from 2 to 3  $\mu\text{m}$ . More densely packed entangled fibrous structure was observed with increasing concentration of the gelator.

- Stimuli responsiveness: The organogel made from PEG-bolaamphiphile exhibited thermal and photo responsive properties. The gelation property of PEG-organogels was found unperturbed up to several cycles of heating and cooling indicating complete thermo-reversibility.

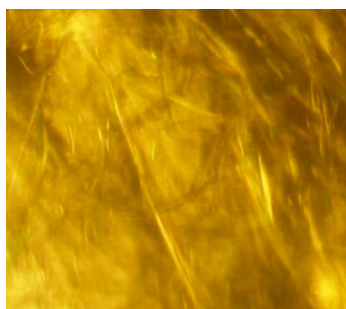


Figure 2. Optical microscopic micrograph of organogel reveals entangled fibrillar network of PEG-bolaamphiphile in organic

solvent.

On the other hand, light induced reversible gel-to-sol transition was achieved for the PEG-organogel upon irradiation with UV light at room temperature, due to the trans-to-cis photo-isomerization of the azo-functional unit. The expected trans-to-cis photo-isomerization was also monitored for PEG-bolaamphiphile in solution upon exposure to the UV light to the appropriate wavelength at room temperature. Figure 3 displays UV-vis absorption spectra of PEG-bolaamphiphile upon UV irradiation at different time interval. The spectra confirms that UV irradiation at the appropriate wavelength on the PEG-bolaamphiphile solution caused photo-isomerization of the azobenzene residue from trans-to-cis state, as indicated by the gradual decrement of the  $\pi \rightarrow \pi^*$  transition band at 358 nm for trans isomer and concomitant increment of the  $n \rightarrow \pi^*$  transition centered at  $\lambda_{\text{max}} = 440 \text{ nm}$  that characteristic for cis isomer upon UV irradiation. Similarly, upon UV irradiation trans-to-cis photo-isomerization led to a gel-to-sol phase transition of the organogel-material. However, the complete gel-to-sol transition required prolonged (~3 to 12 h) UV-light exposure at appropriate wavelength depending on gelator concentration. The formation of cis-isomer of the azo-benzene upon UV-irradiation hindered the supramolecular interaction within the fibrillar network that yielded gel-to-sol phase transition.

Variable concentration fluorescence spectra revealed that the emission peak corresponding to  $\lambda_{\text{max}}$  (em) = 440 nm red-shifted 16 nm with increasing concentration. That suggests 1D J-aggregate formation by PEG-bolaamphiphile with increasing concentration. On the other hand, trans- and cis-isomer showed emission peaks at  $\lambda_{\text{max}}$  (em) = 417 nm and 400 nm, respectively, suggesting J-aggregate formation by trans-isomers.

Thus, trans-PEG-bolaamphiphile self-assembles into one-dimensional (1D) J-aggregates exclusively driven by intermolecular  $\pi$ - $\pi$  interactions among azobenzene moiety. Eventually, the  $\pi$ - $\pi$  non-covalent interaction yields supramolecular fibers in presence of aromatic organic solvents. Further 1D supramolecular fibers entangles into 3D network resulting in viscoelastic-matrix, which can entrap organic solvents in the interstices due to the large

surface area of the fibers that eventually led to the organogel formation.

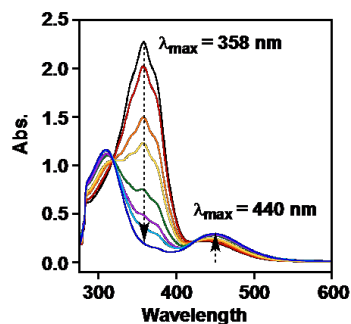


Figure 3. UV-Vis spectra of PEG-bolaamphiphile upon UV irradiation.

## SUPPORT STAFF



**Mr. H. R. Fegade**  
(Instrument Mechanic)



**Mr. S. B. Sonawane**  
(Senior Lab Assistant)



**Mr. A. M. Patil**  
(Lab Assistant)



**Mr. A. R. Rawool**  
(Lab Assistant)



**Mr. S. B. Magdum**  
(Lab Assistant)



**Mr. Y. S. Chandiwade**  
(Lab Attendant)



**Mr. P. B. Rana**  
(Lab Attendant)

## UNDERGRADUATE STUDENTS' SEMINARS/PROJECTS/HOME PAPERS:

Sr. No.	Name of the student	Seminar topic
1	Omkar Chandorkar	Pyrene Based Functional Colorants
2	Tejashree Satpute	Liquid Formulations of Basic Dyes and their Applications
3	Shruti Patil	Bioluminophores
4	Omkar Balel	Perkow and Michaelis-Arbuzov reaction and their Applications
5	Pratik Shinde	Catalytic Applications of Phthalocyanines
6	Henil Lad	Pigments for Solar Applications
7	Akanksha Shridhar	Indigo and Its Derivatives
8	Radhika Thanvi	Fluorescent Brightening Agents for Plastics and Paints
9	Sanket Manjrekar	Dyes for Discharge Printing
10	Siddhant Warrior	Non-Azo Food Colorants
11	Kunal Gondhalekar	Size Reduction Equipments used in Dyestuff Industry
12	Ashlesha Bhide	Brown Dyes for Denim
13	Aamir Nurle	Aminoanthraquinone and Chloroanthraquinone from Nitroanthraquinone
14	Zishaan Momin	Perinone Colorants
15	Kapil Waghmare	Piezochromic Materials and Applications
16	Karishma Kamble	Triplet Photosensitizers
17	Mridul Patwa	Leuco Dyes - Stability and Applications
18	Prateek Mishra	Commercial Sulphonation using SO <sub>3</sub> in Dyestuff Industry
19	Aniket Vartak	Positive Displacement Pumps used in Chemical Industry

## POST GRADUATE STUDENTS' SEMINARS

No.	Name of the Student (Beginning with Last name)	Topic
1	Palande Manasi	Use of supercritical carbon dioxide for carboxylation, asymmetric reduction and esterification
2	Joshi Dharmi	Role of aldehydes in flavor and fragrances
3	Nair Revathi	Synthesis of sandalwood odorants
4	Datey Harsha	Fragrance allergens

## RESEARCH PROJECTS

### PH.D. (TECH)

Sr. No.	Research Scholar (Beginning with Last name)	Previous Institution	Project	Supervisor
1.	More Priyanka	Institute of Chemical technology, Mumbai.	Utilization of bio-catalyst in organic synthesis	Prof. G.S. Shankarling
2	Patil Yogesh	Institute of Technology, Nirma University, Ahmedabad	Dye degradation using metal organic framework	Prof. G.S. Shankarling
3	Joglekar Amruta	Institute of Chemical technology, Mumbai	Development and characterization of specialty colorants using conventional and environmentally benign methods	Prof. G.S. Shankarling
4	Chaturvedi Ankur	Institute of Chemical Technology	Characterization of Ionic Liquids	Prof. G. S. Shankarling
5	Mande Prashant	Institute of Chemical Technology	To be Decided	Prof. N. Sekar

### PH.D. (SCIENCE)

Sr. No.	Research Scholar (Beginning with Last name)	Previous Institution	Project	Supervisor
1.	Moolya Preetam	RPG Life Sciences	Synthesis of High performance colorants	Prof. G. S. Shankarling
2.	Vajekar Shailesh Mumbai	Ruparel College,	Study and synthesis of novel colorant for High-tech application	Prof. G. S. Shankarling
3.	Boraste Deepak	Acoris Research Ltd. Pune	Studies in synthesis and application of pyromethene derivative and cucurbitol host molecules	Prof. G.S. Shankarling
4.	Ghorpade Prashant	VMV College, Amravati	Synthesis of novel deep eutectics and study of deep eutectics mixtures for catalytic action in organic synthesis	Prof. G.S. Shankarling
6.	Gayakwad Eknath	Vidyabharti College Amaravati	Green methodologies for synthesis of novel heterocyclic colorants.	Prof. G.S. Shankarling

7.	Kamble Sujit	Evotec India Ltd., India	Green approach in synthesis of heterocyclic compounds and synthesis of novel colorants.	Prof. G.S. Shankarling
8.	Pant Preeti	V, G. Vaze College, Mumbai.	Synthesis of colourants for functional applications and implementation of green principles in organic reactions.	Prof. G.S. Shankarling
9.	Rathi Jyoti	Vidyabharti College Amaravati	Implementation of Chiral Deep Eutectic solvent for selective organic synthesis.	Prof. G.S. Shankarling
10.	Khopkar Sushil	University department Chemistry, Mumbai.	Synthesis, photophysical properties and application of novel squaraines	Prof. G.S. Shankarling
11.	Jachak Mahesh	Centaur Pharmaceuticals Pvt. Ltd	Synthesis of novel colorants for metal sensor applications and ink jet ink formulations.	Prof. G.S. Shankarling
12.	Patel Khushbu	University department Chemistry, Mumbai.	Synthesis of grapheme oxide and its functionalized derivatives as an promising catalysts for organic transformations	Prof. G.S. Shankarling
13	Mehta Viral	Mithibai College, Mumbai	To be decided	Prof. G.S. Shankarling
14	Jadhav Manoj	KET's V. G. Vaze College. Mulund, Mumbai.	Synthesis of Novel Colorants for Dyes Sensitized Solar Cells	Prof. N. Sekar
15	Patil Sharad	North Maharashtra University, Jalgaon.	Greener Routes for Heterocyclic Intermediate in synthesis of Fluorescent Colorants.	Prof. N. Sekar
16	Kothavale Shantaram	Abasaheb Garware College, Pune.	Synthesis of Fluorescent Colorants for their Biological Applications	Prof. N. Sekar
18	Shreykar Milind	KET's V. G. Vaze College. Mulund, Mumbai.	Synthesis of novel red emitting coumarins and ESIPT dyes for functional applications.	Prof. N. Sekar
19	Thakare Shrikant	Vidyabharti Mahavidyalaya Amaravati	Synthesis of High Performance Fluorescent Colorants with Enhanced Photo physical properties	Prof. N. Sekar

20	Ghorpade Seema	Shivaji University Kolhapur	Synthesis high performance fluorescent colorants and their biological applications	Prof. N. Sekar
21	More Ankush	S.S.G.M. College, Kopargon	Design and synthesis of efficient fluorescent dyes with enhanced photophysical properties	Prof. N. Sekar
22	Kataria Santosh	Ahmednagar College0	Synthesis of fused heterocycles with high hyperpolarisability	Prof. N. Sekar
23	Borade Nandkumar	New Arts, Science and Commerce College Ahmednagar	Greener methods for the synthesis of fluorescent fused heterocycles	Prof. N. Sekar
24	Jadhav Siddheshwar	Shivaji University	Synthesis of fused heterocyclic fluorophores with non linear optical properties	Prof. N. Sekar
25	Warde Umesh	Ahmednagar College	Synthesis of Novel High Performances Functional Colorants	Prof. N. Sekar
26	Mallah Ramnath	Birala College Kalyan	Synthesis of Highly Fluorescent Fused Heterocyclic Compounds	Prof. N. Sekar
27	Mallah Ramnath	Birala College Kalyan	Synthesis of Highly Fluorescent Fused Heterocyclic Compounds	Prof. N. Sekar
28	Gawale Yogesh	B.N.N College, Bhiwindi, Thane	Synthesis and photophysical properties of functional molecules	Prof. N. Sekar
29	Erande Yogesh	S.S.G.M. College, Kopargon	Greener Methods for Synthesis of Heterocyclic Compounds	Prof. N. Sekar
30	Archana Bhagwat	New Arts, Science and Commerce College Ahmednagar	Synthesis and Photophysical Properties of Polycyclic Fluorescent Compounds	Prof. N. Sekar
31	Amol Jadhav	Department of Chemistry Shivaji University	Synthesis of High Performance Fluorescent Fused Heterocyclic Systems	Prof. N. Sekar
32	Kiran Ahavad	Ahmednagar College, Ahmednagar	Synthesis and Applications of Heterocyclic Fluorescent ESIPT Fluorophore	Prof. N. Sekar



33	Dhanraj Mobyia	Department of Chemistry, Mumbai University	Synthesis of novel fluorescent dyes and their applications	Prof. N. Sekar
34	Manali Rajashirake	M .S. University, Badoda	Synthesis of High performance Fluorescent colourants for functional applications	Prof. N. Sekar
35	Mayuri Kadam	Department of Chemistry, Mumbai University	Synthesis of novel fused heterocyclic fluorescent compounds and their applications	Prof. N. Sekar
36	Prerana Lokhande	Department of Chemistry, ICT, Mumbai	Synthesis of novel fluorescent colorants	Prof. N. Sekar
37	Dinesh Patil	North Maharashtra University, Jalgaon.	Synthesis of Novel fluorescent fused heterocyclic colorant systems	Prof. N. Sekar
38	Sulochana Bhalekar	Ahmednagar college, Ahmednagar	Synthesis of fluorescent colourants	Prof. N. Sekar
39	Manish Raikwar	The D.G. Ruparel College	Synthesis of highly fluorescent heterocyclic compounds	Prof. N. Sekar
40	Suvidha Shinde	Department of Textiles and fibre processing and technology department, ICT, Mumbai	Application of fluorescent dyes on textile and leather substrate	Prof. N. Sekar&Prof. R.V. Adivarekar(Co-guide)
41	Mishra Virendra	University Of Mumbai. Kalina.	Synthesis of Fluorescent reactive dyes & their intermediates	Prof. N. Sekar
42	Nitesh N Ayare	ICT Mumbai.	Synthesis of fluorescent dyes with high performance.	Prof. N. Sekar
43	Yadav Sagar B.S.	University of Mumbai, Kalina.	Synthesis of Heterocyclic Dyes with High performance Fluorescence.	Prof.N.Sekar
44	Ramugade Supriya H.	ICT, Mumbai.	Synthesis and application of photostable dyes on textiles	Prof.N.Sekar & Prof. R.V. Adivarekar(Co-guide)
45	Ghanavatkar Chaitannya Waman	Gogate Jogalekar college Ratnagiri	Synthesis of photostable and Fluorescent reactive dyes & their intermediates	Prof.N.Sekar

46	Sharma Suryapratap	The Institute of Science , Mumbai	To be decided	Prof.N.Sekar
47	Vadagaonkar Kamlesh Shashikant	H.P.T. Arts and R.Y.K. Science college, Nashik	Development of Synthetic Methodologies Leading to Functional Colorants, Heterocycles, Ketoesters and Amides	Prof. P. M. Bhate
48	Nazim Ahmad Abdul Aleem	Shri Shivaji College of Arts, Commerce & Science College, Akola	Multicomponent approach for the synthesis of some heterocyclic systems	Prof. P. M. Bhate
49	Garande Ashok Malappa	Ahmednagar College, Ahmednagar	Attempts at structural elucidation of Cherimoline and synthesis of quinazoline and quinoxaline based heterocycles.	Prof. P. M. Bhate
50	Dugane Rajaram Gangaram	Department of Chemistry, Dr.Babasaheb Ambedkar Marathawada Univrsity, Aurngabad	Studies in Chiral synthesis	Prof. P. M. Bhate
51	Rajkumari Vijilata Devi	Ahmednagar College, Ahmednagar.	Development of a novel reactive dye system based on diazonium salts and synthesis of quinoxalines, quinazolines and benzodiazepines	Prof. P. M. Bhate
52.	Dattatray Appasha Pethsangave	Dr. B.A.M.U. Aurangabad	Graphene supported chiral reagent	Dr. Surajit Some
53.	Rahul Vijay Khose	Wilson college, Mumbai	Tunable laser properties of dye decorated graphene derivatives	Dr. Surajit Some
54.	Pravin Wadekar	Institute of science Mumbai	Synthesis of 3D, fixable heteroatom doped carbon based metal oxide containing nanocomposites for its high-performance supercapacitor application	Dr. Surajit Some
55	Jejurkar Valmik Pandurang	University of Pune	Design and Synthesis of Novel Organic Dyes Based on Trogers's Base (TB) Architecture for Efficient Dye Sensitized Solar Cells (DSSC), DST-SERB	Dr. Satyajit Saha

## M. TECH.

Sr. No.	Research Scholar (Beginning with Last name)	Previous Institution	Project	Supervisor
1	Joshi Dharmee M.Tech Perfumery	University Institute Of Chemical Technology, Jalgaon	Synthesis of fragrance and flavor ingredients using DES and Ionic liquids	Prof. G.S. Shankarling
2	Nair Revathi M.Tech Perfumery	SIES Graduate school of technology, Mumbai University	Synthesis and Application Of Ionic Liquis and fragrance release study	Prof. G.S. Shankarling
3	Datey Harsha M.Tech Perfumery	Priyadarshini Institute of Engineering and technology, Nagpur	Synthesis and Extraction using Ionic Liquiss(DIMCARB)	Prof. G.S. Shankarling
4	Palande Manasi M.Tech.Green tech	D.Y.Patil, Belapur	Synthesis of thiozolidinone, and extraction of Areca Husk	Prof. G.S. Shankarling

## POSTDOCTORAL STUDENTS

No.	Research Scholar (Beginning with Last name)	Previous Institution	Project	Supervisor
1	Dr. Dipti Lakhe	IIT BOMBAY	Synthesis of novel fluorescent cyanine dyes for High technology application	Prof. N. Sekar

## DETAILS OF SPONSORED PROJECTS

### GOVERNMENT AGENCIES:

Sponsor	Title	Duration	Total amount (Rs.)	Principal Investigator	Research Fellows
AICTE-RPS	Synthesis of novel perimidine and quinaldine based NIR absorbing squaraines dyes and study of their thermal and photophysical properties	Three Years	750000/-	Prof. G.S. Shankarling	Sushil Khopkar
DAE-BRNS	Development and characterization of selective coating for enhancement of radiation absorption of solar receivers.	Two Years	1, 43, 35,000/-	Prof. G.S. Shankarling/ Dr. V. D. Deshpande	Amruta Joglekar

DAE-BRNS	Synthesis and Purification of Spectroscopic grade Cucurbituril[7] for high power aqueous dye laser applications	Three Years	30,44,800 /-	Prof. G.S. Shankarling	Deepak Boraste
Principal Scientific Advisor to GOI PSA -II (DST)	Development & Optimization Studies with an alternate route for vinylsulphones and Novel vinylsulphones	3 year	Rs. 59,13,000	Prof. N. Sekar	Mr.Virendra R. Mishra Mr. Chaitanya W. Ghanvatkar
DST	Coloured fluorescent conducting oligomers / monomers for dye sensitized solar cell	3 Year	88,78,099	Prof. N. Sekar	Mr.Suryapratap Sharma
DST	Designing and synthesis of novel fluorescent cyanine dyes for Hi-technology application	3 Year	30, 00,000	Prof. N. Sekar	Ms. Dipti Lakhe Chawade (Post-Doctorate Research Fellow)
Ministry of Textiles	Novel Reactive Dye System Based on Diazonium Salts	3 years	Rs 27.84 lacs	Prof Prakash Bhate	Rajkumari Vijilata Devi
UGC	Graphene supported chiral reagent	3years	6 Lacs	Dr. Surajit Some	Dattatray Appasha Pethsangave
BRNS	Tunable laser properties of dye decorated graphene derivatives	3 years	27.78 Lacs	Dr. Surajit Some	Dattatray Appasha Pethsangave
DST-SERB	Synthesis of 3D, fixable heteroatom doped carbon based metal oxide containing nanocomposites for its high-performance supercapacitor application	3 years	25.81 Lacs	Dr. Surajit Some	Dattatray Appasha Pethsangave
SERB-DST	Design and Synthesis of Novel Organic Dyes Based on Trogers's Base (TB) Architecture for Efficient Dye Sensitized Solar Cells (DSSC)	3 years (2015-2018)	Rs. 29,99,000	Dr. Satyajit Saha	Valmik Jejurkar Pandurang

CSIR	A Novel Approach Of Rational Catalyst Design For The Direct Enantioselective $\alpha$ -Allylation/Alkylation Of Ketones	3 years (2016-2019)	Rs. 25 46,000	Dr. Satyajit Saha	Dr. Rajpratap Kshatriya
UGC	Co-operative Organocatalysts for Enantioselective Transformations	2 years (2015-2017)	Rs. 6,00,000	Dr. Satyajit Saha	-
UGC	Synthesis and application of novel water soluble organic and inorganic small molecules for bio-mimicking applications	2 years, 2016 - 2018	6 lac	Dr. Nabanita Sadhukhan	----
DST - SERB	Synthesis and characterization of amphiphilic PEG foldamer for mimicking stimuli-responsive ion pump	3 years, 2015 - 2018	20.3 lac	Dr. Nabanita Sadhukhan	----

#### PRIVATE AGENCIES /INDUSTRIES:

Sponsor	Title	Duration	Total amount	Principal Investigator	Research Fellows
Transition Optical Corporation, USA	Synthesis of Azo and anthraquinone dyes.	One year	20,00,000 /-	Prof. G. S. Shankarling	Rishikant Sonune
Essilor International Ltd.	Development of IPP resistant Blue dye and UV-absorber	One year	26,00,000/-	Prof.G.S. Shankarling	Dr. Haribhau Kumbhar
Deepak Nitrite Ltd	Synthesis of optical brightening agents	One year	9,50,000 /-	Prof.G.S. Shankarling	Mr. Anand Parashar
Cavincare	Synthesis of Hair Dyes	1 Year	5,00,000 /-	Prof. N. Sekar	Mr. Prashant Mande

#### DETAILS OF NATIONAL AND INTERNATIONAL COLLABORATIONS:

##### PROF. G.S. SHANKARLING

- Dr. Douglas McFarlane and Dr. Vijay Raghvan, Monatsche University, Australia.
- Dr. Suban Sahoo, SVNIT, Gujarat.
- Dr. Hirendra Gosh, BARC, Mumbai.
- Dr. Alok Ray, BARC, Mumbai.
- Dr. Shakti Vinay Shukla, Principle Director, Fragrance and Flavor Development Center (FFDC), Kannauj, U.P

## PUBLICATIONS (PEER REVIEWED):

No.	Title and authors	Journal	Vol. No.	Pages	Year
1	A thiazoloquinoxaline based "turn-on" chemodosimeter for detection of copper ions Deshpande, S.S., Khopkar, S.S., Shankarling, G.S	Dyes and Pigments	147	393-399	2017
2	Metal-free oxidation of aldehydes to acids using the 4Na <sub>2</sub> SO <sub>4</sub> -2H <sub>2</sub> O <sub>2</sub> -NaCl adduct Gayakwad, E.M., Patil, V.V., Shankarling, G.S.	Environmental Chemistry Letters	15(3)	459-465	2017
3	Process intensification in azo dyes Shankarling, G.S., Deshmukh, P.P., Joglekar, A.R	Journal of Environmental Chemical Engineering	5(4)	3302-3308	2017
4	Deep Eutectic Solvent/Lipase: Two Environmentally Benign and Recyclable Media for Efficient Synthesis of N-Aryl Amines Pant, P.L., Shankarling, G.S.	Catalysis Letters	147(6)	1371-1378	2017
5	Reversible 'turn off' fluorescence response of Cu <sup>2+</sup> ions towards 2-pyridyl quinoline based chemosensor with visible colour change More, P.A., Shankarling, G.S.	Sensors and Actuators, B: Chemical	241	552-559	2017
6	Solvatochromic fluorescence properties of phenothiazine-based dyes involving thiazolo[4,5-b]quinoxaline and benzo[e]indole as strong acceptors Deshpande, S.S., Kumbhar, H.S., Shankarling, G.S.	Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy	174	154-163	2017
7	Choline based ionic liquids and their applications in organic transformation Gadilohar, B.L., Shankarling, G.S.	Journal of Molecular Liquids	227	234-261	2017
8	An Effect of H-bonding in Synthesis of 1, 5-Diketones via Tandem Aldol-Michael Addition Reaction Using Room Temperature Ionic Liquid (RTIL). Kamble, S.S., Shankarling, G.S.	ChemistrySelect	2(5)	1917-1924	2017
9	Energy efficient Pfitzinger reaction: A novel strategy using a surfactant catalyst More, P.A., Shankarling, G.S	New Journal of Chemistry	41(21)	12380-12383	2017
10	Deep Eutectic Solvent: An Efficient and Recyclable Catalyst for Synthesis of Thioethers. Pant, P.L., Shankarling, G.S.	ChemistrySelect	2(25)	7645-7650	2017

11	Deep Eutectic Solvent: An Efficient Catalyst for C-O Coupling Reactions. Pant, P.L., Shankarling, G.S.	ChemistrySelect	2(17)	4892-4898	2017
12	Efficient, facile metal free protocols for the bromination of commercially important deactivated aminoanthracene-9,10-diones Patil, V.V., Gayakwad, E.M., Patel, K.P., Shankarling, G.S.	Tetrahedron Letters	58(26)	2608-2613	2017
13	[Amberlyst-15 - (4Na <sub>2</sub> SO <sub>4</sub> -2H <sub>2</sub> O <sub>2</sub> -NaCl) Adduct]: Direct Access to Synthesize Acylureas via Oxidative Amidation of Aldehyde Gayakwad, E.M., Patil, V.V., Patel, K.P., Shankarling, G.S.	ChemistrySelect	2(29)	9511-9515	2017
14	Amberlyst-15 catalysed oxidative esterification of aldehydes using a H <sub>2</sub> O <sub>2</sub> trapped oxidant as a terminal oxidant Gayakwad, E.M., Patil, V.V., Shankarling, G.S.	New Journal of Chemistry	41(7)	2695-2701	2017
15	pH-Responsive Interaction of Fluorogenic Antimalarial Drug Quinine with Macrocyclic Host Cucurbit[7]uril: Modulations in Photophysical and Acid-Base Properties Boraste, D.R., Chakraborty, G., Ray, A.K., Shankarling, G.S., Pal, H.	ChemistrySelect	2(18)	5128-5142	2017
16	Concentrated solar radiation aided energy efficient protocol for oxidation of alcohol using task specific ionic liquid- choline peroxydisulfate Gandilohar, B.L., Deshpande, S.S., Pinjari, D.V., Shankarling, G.S.	Solar Energy	139	328-336	2016
17	Photoswitchable conjugated assembly involving fluorescent boranil Deshpande, S., Kumbhar, H., Shankarling, G	Journal of Luminescence	179	314-321	2016
18	Dihydroquinazolinone based "turn-off" fluorescence sensor for detection of Cu <sup>2+</sup> ions Borase, P.N., Thale, P.B., Shankarling, G.S.	Dyes and Pigments	134	276-284	2016
19	A "turn on" fluorescent and chromogenic chemosensor for fluoride anion: Experimental and DFT studies Thale, P.B., Borase, P.N., Shankarling, G.S.	Inorganic Chemistry Frontiers	7	977-984	2016

20	An Energy Efficient Sonochemical Selective Oxidation of Benzyl Alcohols to Benzaldehydes by Using Bio-TSIL Choline Peroxydisulfate Gadilohar, B.L., Pinjari, D.V., Shankarling, G.S.	Industrial and Engineering Chemistry Research	55	4797-4802	2016
21	Novel, solid-state, highly fluorescent ketoiminate spiroborates with aggregation induced emission Kumbhar, H.S., Deshpande, S.S., Shankarling, G.S.	Dyes and Pigments	127	161-169	2016
22	M-CPBA mediated metal, free, rapid oxidation of aliphatic amines to oximes Patil, V.V., Gayakwad, E.M., Shankarling, G.S.	Journal of Organic Chemistry	81	781-786	2016
23	Exciton delocalization and hot hole extraction of CdSe QDs and CdSe/ZnS type 1 core shell QDs sensitized with newly synthesized thiols Singhal, P., Ghorpade, P.V., Shankarling, G.S., Tripathi, R.M., Ghosh, H.N.	Nanoscale	8	1823-1833	2016
24	Nonanebis (peroxoic acid) mediated efficient and selective oxidation of sulphide Gayakwad, E.M., Patil, V.V., Shankarling, G.S.	New Journal of Chemistry	40	223-230	2016
25	Transamidation catalyzed by a magnetically separable Fe <sub>3</sub> O <sub>4</sub> nano catalyst under solvent-free conditions Thale, P.B., Borase, P.N., Shankarling, G.S.	RSC Advances	6	52724-52728	2016
26	A choline hydroxide catalysed synthesis of 2,3-dihydroquinazolin-4(1:H)-ones in an aqueous medium	RSC Advances	6	63078-63083	2016
27	Red emitting NLO phoric 3-styryl coumarins ; Experimental and computational studies. Tathe A.,Sekar N.	Optical materials	51	121-127	2016
28	Aggregation induced emissive carbazole-based push-pull NLO phores ; synthesis, photophysical properties and DFT studies. Lanke s.,Sekar N.	Dyes and pigments	124	82-92	2016
29	A new type of triphenylamine based coumarine-rhodamine hybrid compound ; synthesis, Photophysical properties, Viscosity sensitivity and energy transfer. Kothavale S.,Sekar N.	RSC ADVANCES	6(107)	105387-105397	2016



30	Synthesis and optical response to acids and bases of a new styryl—dihydro-benzo[a]phenazine chromophores Patil, S.R., Choudhary, A.S., Sekar, N.	Tetrahedron	72(49)	pp. 7968-7974	2016
31	Acridine-1, 8-diones – A new class of thermally stable NLOphores: Photophysical, (hyper)polarizability and TD-DFT studies Thorat, K.G., Tayade, R.P., Sekar, N.	Optical Materials	62,	pp. 306-319	2016
32	Indole-Based NLOphoric Donor- $\pi$ -Acceptor Styryl Dyes: Synthesis, Spectral Properties and Computational Studies Chemate, S., Sekar, N.	Journal of Fluorescence	26 (6),	pp. 2063-2077	2016
33	NLOphoric and solid state emissive BODIPY dyes containing N-phenylcarbazole core at meso position – Synthesis, photophysical properties of and DFT studies Telore, R.D., Jadhav, A.G., Sekar, N.	Journal of Luminescence	179,	pp. 420-428	2016
34	Synthesis of triazine based dialdehyde Schiff's base – new templates for Molecular Imprinting and study of their structural and photophysical properties Padalkar, V.S., Tathe, A.B., Sekar, N.	Arabian Journal of Chemistry	9,	pp. S1793-S1800	2016
35	Novel Rhodafluors: Synthesis, Photophysical, pH and TD-DFT Studies Patil, S.S., Thorat, K.G., Mallah, R., Sekar, N	Journal of Fluorescence	26 (6), pp. 2187-2197	pp. 2187-2197	2016
36	Synthesis and antimicrobial activity of novel 2-substituted benzimidazole, benzoxazole and benzothiazole derivatives Padalkar, V.S., Borse, B.N., Gupta, V.D., Phatangare, K.R., Patil, V.S., Umape, P.G., Sekar, N.	Arabian Journal of Chemistry	9,	pp. S1125-S1130	2016
37	Solvatochromism, halochromism, and azo–hydrazone tautomerism in novel V-shaped azo-azine colorants – consolidated experimental and computational approach Choudhari, A.S., Patil, S.R., Sekar, N.	Coloration Technology	132 (5),	pp. 387-398.	2016
38	Solvent-Driven Conformational Exchange for Amide-Linked Bichromophoric BODIPY Derivatives Thakare, S., Stachelek, P., Mula, S., More, A.B., Chattopadhyay, S., Ray, A.K., Sekar, N., Ziessel, R., Harriman, A.	Chemistry - A European Journal	22 (40),	pp. 14356-14366	2016

39	Resonance induced proton transfer leading to NIR emission in coumarin thiazole hybrid dyes: Synthesis and DFT insights Shreykar, M.R., Sekar, N	Tetrahedron Letters	57 (37)	pp. 4174- 4177	2016
40	Comprehensive DFT and TD-DFT Studies on the Photophysical Properties of 5,6-Dichloro-1,3-Bis(2-Pyridylimino)-4,7-Dihydroxyisoindole: A New Class of ESIPT Fluorophore Kataria, S., Rhyman, L., Ramasami, P., Sekar, N.	Journal of Fluorescence	26 (5),	pp. 1805- 1812	2016
41	Synthesis and Antimicrobial Activities of Novel 2-[substituted-1H-pyrazol-4-yl] Benzothiazoles, Benzoxazoles, and Benzimidazoles Padalkar, V.S., Borse, B.N., Gupta, V.D., Phatangare, K.R., Patil, V.S., Sekar, N.	Journal of Heterocyclic Chemistry	53 (5),	pp. 1347- 1355	2016
42	Solvatochromism, halochromism, and azo-hydrazone tautomerism in novel V-shaped azo-azine colorants – consolidated experimental and computational approach Choudhari, A.S., Patil, S.R., Sekar, N.	Coloration Technology	132 (5),	pp. 387- 398	2016
43	Solvent-Driven Conformational Exchange for Amide-Linked Bichromophoric BODIPY Derivatives Thakare, S., Stachelek, P., Mula, S., More, A.B., Chattopadhyay, S., Ray, A.K., Sekar, N., Ziessel, R., Harriman, A.	Chemistry - A European Journal,	22 (40),	pp. 14356- 14366.	2016
44	Resonance induced proton transfer leading to NIR emission in coumarin thiazole hybrid dyes: Synthesis and DFT insights Shreykar, M.R., Sekar, N.	Tetrahedron Letters	57 (37),	pp. 4174- 4177	2016
45	Comprehensive DFT and TD-DFT Studies on the Photophysical Properties of 5,6-Dichloro-1,3-Bis(2-Pyridylimino)-4,7-Dihydroxyisoindole: A New Class of ESIPT Fluorophore Kataria, S., Rhyman, L., Ramasami, P., Sekar, N	Journal of Fluorescence	26 (5),	pp. 1805- 1812	2016
46	Synthesis and Antimicrobial Activities of Novel 2-[substituted-1H-pyrazol-4-yl] Benzothiazoles, Benzoxazoles, and Benzimidazoles Padalkar, V.S., Borse, B.N., Gupta, V.D., Phatangare, K.R., Patil, V.S., Sekar, N.	Journal of Heterocyclic Chemistry	53 (5),	pp. 1347- 1355	2016

47	Dispersant-free disperse dyes for polyester an eco-friendly approach Meena, C.R., Maiti, S., Sekar, N., More, S., Adivarekar, R.V.	Journal of the Textile Institute	Article in press	pp. 1-6	2016
48	Red and near-infrared emitting bis-coumarin analogues based on curcumin framework-synthesis and photophysical studies Margar, S.N., Sekar, N.	Journal of Photochemistry and Photobiology A: Chemistry	327,.	pp. 58-70	2016
49	Novel 2H-pyran-3-carbonitrile dyes - Synthesis, solvatochromism study, and DFT, TD-DFT computations Tayade, R.P., Sekar, N.	Journal of Luminescence	176,	pp. 298-308	2016
50	Fluorescent difluoroboron-curcumin analogs: An investigation of the electronic structures and photophysical properties Margar, S.N., Rhyman, L., Ramasami, P., Sekar, N	Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy	152, art. no. 13963,	pp. 241-251	2016
51	NLOphoric Carbazole-Containing Push-Pull Extended Styryl Chromophores: Study of Photophysical Properties by Solvatochromic and DFT Method Telore, R.D., Sekar, N.	Journal of Fluorescence	26 (4),	pp. 1261-1270	2016
52	Red Emitting Coumarin—Azo Dyes : Synthesis, Characterization, Linear and Non-linear Optical Properties-Experimental and Computational Approach Tathe, A.B., Sekar, N.	Journal of Fluorescence	26 (4),	pp. 1279-1293	2016
53	Nonlinear optical properties of curcumin: solvatochromism-based approach and computational study Margar, S.N., Sekar, N.	Molecular Physics	114 (12),	pp. 1867-1879	2016
54	Carbazole-containing push-pull chromophore with viscosity and polarity sensitive emissions: Synthesis and photophysical properties Telore, R.D., Sekar, N.	Dyes and Pigments	129,	pp. 1-8	2016
55	Red-emitting NLOphoric carbazole-coumarin hybrids-Synthesis, photophysical properties and DFT studies Tathe, A.B., Sekar, N	Dyes and Pigments	129,	pp. 174-185	2016

56	Unfolding ESIPT in Bis-2,5-(2-benzoxazolyl) Hydroquinone and 2,5-Bis(benzo[d]oxazol-2-yl)-4-methoxyphenol: a Comprehensive Computational Approach Jadhav, M.M., Rhyman, L., Ramasami, P., Sekar, N.	Journal of Fluorescence	Article in press	pp. 1-13	2016
57	Novel NLOphoric 2-methoxy carbazole-based push pull chromophores: Synthesis, photophysical properties and TD-DFT Study Lanke, S.K., Sekar, N.	Journal of Photochemistry and Photobiology A: Chemistry	321,	pp. 63-71	2016
58	Coumarin Push-Pull NLOphores with Red Emission: Solvatochromic and Theoretical Approach Lanke, S.K., Sekar, N	Journal of Fluorescence	26 (3),	pp. 949-962	2016
59	Benzimidazole-thiazole based NLOphoric styryl dyes with solid state emission - Synthesis, photophysical, hyperpolarizability and TD-DFT studies Tayade, R.P., Sekar, N	Dyes and Pigments	128,	pp. 111-123	2016
60	Pyrazole based NLOphores: Synthesis, photophysical, DFT, TDDFT studies Lanke, S.K., Sekar, N	Dyes and Pigments	127,	pp. 116-127	2016
61	AIE Based Coumarin Chromophore-Evaluation and Correlation between Solvatochromism and Solvent Polarity Parameters Lanke, S.K., Sekar, N.	Journal of Fluorescence	26 (2),	pp. 497-511	2016
62	NLOphoric Red Emitting Bis Coumarins with O-BF <sub>2</sub> -O core-Synthesis, Photophysical Properties and DFT Studies Tathe, A.B., Sekar, N	Journal of Fluorescence	26 (2),	pp. 471-486	
63	Pyrazole based solid state emissive NLOphores with TICT characteristics: Synthesis, DFT and TDDFT studies Lanke, S.K., Sekar, N.	Dyes and Pigments	126,	pp. 62-75	2016
64	Light fast monoazo dyes with an inbuilt photostabilizing unit: Synthesis and computational studies Bhide, R., Jadhav, A.G., Sekar, N.	Fibers and Polymers	17 (3),	pp. 349-357	2016
65	A new type of triphenylamine based coumarin-rhodamine hybrid compound: Synthesis, photophysical properties, viscosity sensitivity and energy transfer Kothavale, S., Sekar, N.	RSC Advances	6 (107),	pp. 105387-105397	2016

66	Novel triphenylamine based rhodamine derivatives: Synthesis, characterization, photophysical properties and viscosity sensitivity Kothavale, S., Sekar, N.	RSC Advances	6 (102),	pp. 100271-100280	2016
67	Red emitting NLOphoric 3-styryl coumarins: Experimental and computational studies Tathe, A.B., Sekar, N	Optical Materials	51,	pp. 121-127	2016
68	Aggregation induced emissive carbazole-based push pull NLOphores: Synthesis, photophysical properties and DFT studies Lanke, S.K., Sekar, N	Dyes and Pigments	124,	pp. 82-92	2016
69	Acridine derivative as a "turn on" probe for selective detection of picric acid: Via PET deterrence Chemate, S., Erande, Y., Mohbiya, D., Sekar, N	RSC Advances	6 (87),	pp. 84319-84325	2016
70	NIR-emitting quinone-fused coumarin dyes: aqueous mediated, catalyst free synthesis and their optical properties Patil, S.R., Choudhary, A.S., Sekar, N.	Tetrahedron Letters	57 (29),	pp. 3100-3104	2016
71	A Lawsons-DAMN based colorimetric chemosensor for rapid naked-eye detection of mercury(II) Patil, S.R., Choudhary, A.S., Sekar, N.	New Journal of Chemistry	40 (8),	pp. 6803-6811	2016
72	Ferrier reaction in a deep eutectic solvent. Sunil M. Rokade and Prakash M. Bhate	Carbohydrate Research	415	28-30	2015
73	One-pot synthesis of per-O-acetylated hemiacetals from free sugars in a deep eutectic solvent. Sunil M. Rokade and Prakash M. Bhate	Carbohydrate Research	416	21-23	2015
74	A serendipitous synthesis of 11a-hydroxy-11,11a-dihydro-benzo-[e]indeno[2,1 b][1,4]-diazepine-10,12-dione derivatives by condensation of 2 aminobenzamides with ninhydrin in water. Rajkumari Vijilata Devi, Ashok M. Garande, Dilip K. Maity,* and Prakash M. Bhate*	J. Org. Chem.	81	1689-1695	2016
75	Thermal and Lewis acid promoted intramolecular Diels-Alder reaction of furanose tethered 1,3,9-decatriene systems: A synthetic and computational investigation Kalmode, H.P. Maity, D.K.*, Bhate, P.M.*	RSC Advances	6	63445-63462	2016

76	Synthesis of Isoindolo[2,1-a]quinazoline, Isoindolo[2,1-a]pyrrolo [2,1-c]quinoxalione, and Indolo[1,2-a]isoindolo[1,2-c]quinoxalinone Derivatives in a Deep Eutectic Solvent Rajkumari Vijilata Devi, Ashok M. Garande, and Prakash M. Bhate*	Synlett	27	2807-2810	2016
77	Graphene- iodine nano-composites: Highly potent bacterial inhibitors that are bio-compatible with human cells Surajit Some, Ji Soo Sohn, Junmoo Kim, Su-Hyun Lee, Su Chan Lee, Jungpyo Lee, Iman Shackery, Sang Kyum Kim <sup>3</sup> , So Hyun Kim, NakwonChoi, Il-JooCho, Hyo-Il Jung, Shinill Kang & SeongChan Jun.	Scientific reports	6	20015	2016
78	Graphene Derivative As a Highly Efficient Nitrosonium Source: A Reusable Catalyst for Diazotization and Coupling Reaction. Dattatray A. Pethsangave, Rahul V. Khose, Atul C. Chaskar, Seong Chan Jun, and Surajit Some*	Chemistry Select	1	6933 – 6940	2016
79	Ultrasound-Promoted Enantioselective Decarboxylative Protonation of $\alpha$ Aminomalonate Hemiesters by Chiral Squaramides: A Practical Approach to Both Enantiomers of $\alpha$ -Amino Esters. Surajit Some, Han Yong Bae, Mun Jong Kim, Yong Jian Zhang* and Choong Eui Song*	Eur. J. Org. Chem.		4562–4565	2017

## PATENTS:

No.	Inventors	Title	Country	Funding agency
1	Shankarling G.S.; Boraste Deepak	Process for preparing Cucurbituril in high yield	India	BARC
2	Shankarling G.S.; Joglekar Amruta	Synthesis of copper phthalocyanine using Deep Eutectic Solvent.	India	-
3.	Surajit Some, Seong Chan Jun and Min Sik NAM	Flame retardant comprising GO doped phosphorous on the surface	United states	Yonsei Univesity

4.	Surajit Some and Hyoyoung Lee	Graphene derivative based composition for drug delivery and preparation method thereof	United states	Sungkyunkwan University
5.	Surajit Some and Dattatray A. Pethsangave.	Graphene Supported Green Approach for Highly Efficient Fire Retardant	Indian	Institute of Chemical Technology, Matunga, Mumbai, India.
6.	Surajit Some, Dattatray A. Pethsangave and Pushpito Ghosh.	Magnetic Graphene- Carragenan-Iron Oxide Composite for absorption of Oils with recycle and reuse	Indian	Institute of Chemical Technology, Matunga, Mumbai, India.

### BOOK CHAPTER:

No.	Author(s)	Title of the chapter	Editor	Publisher	Place	Year	Page
1.	Prof. G. S. Shankarling	Culture of Indigo in Asia	Kapila Vatsyayan	Niyogi Books	New Delhi	2014	122-134

### MEMBERSHIP OF IN-HOUSE COMMITTEES:

#### PROF. G. S. SHANKARLING

- Member, Board of governors, SVIMS
- Department coordinator of TEQUIP
- Tequip in charge of student training programme
- Administrative Co-coordinator for Perfumery and Flavors Course.
- Placement Officer of Perfumery & Flavor Technology
- Member of Merit-cum-means and Trust scholarship, ICT
- Co-Chairperson of Publication committee (Annual Report, Student diary, ICT diary, and Posters)

#### PROF. N. SEKAR

- Co-ordinator for the Centre for Physico-Chemical Aspects in Textiles, Fibres, Dyes and Polymers (UGC-SAP).
- Deputy Coordinator, COSIST Programme
- Departmental Representative, CAS Programme
- Coordinator, In-plant Training for T.Y. B. Tech students
- Coordinator, TEQIP Seminar (Services to Society)
- Member, Student's Feedback committee
- Member, AICTE –

Accreditation (of all Courses) Committee

- Member, Teachers Evaluation Committee
  - Member, RC Committee Ph. D Chemistry
  - Member, RC Committee, Ph. D Green Technology
  - Member, RC Committee, Dyes Technology
  - Seminars /Lectures / Conferences /Symposia / Workshops /Summer or Winter Training Schools attended/Oral OR Poster Presentations
- DR. NABANITA SADHUKHAN**
- Library Committee

## SEMINARS/ LECTURES/ CONFERENCES/ SYMPOSIA/ WORKSHOPS/SUMMER OR WINTER TRAINING SCHOOLS ATTENDED/ORAL OR POSTER PRESENTATIONS:

### PROF. G. S. SHANKARLING

- Oral presentation on "Wealth creation opportunities through sustainable waste management" by Prof. Ganapati S. Shankarling\* in Short Term Training Program (STTP) Organized by Department of Chemical Engineering, SVU College of Engineering, Tirupati.
- Oral presentation on "Dihydroquinazolinone based "turn-off" fluorescence sensor for detection of Cu<sup>2+</sup> ions" by Mr. Pravin Borase, Ms. Pranila Thale, Ganapati S. Shankarling\* in "National Symposium on Functional Applications of Colourants NSFAC", 2016. held at Institute of chemical technology, Mumbai.
- Oral presentation on "Choline peroxydisulfate oxidizing Bio-TSIL: triple role player in the one-pot synthesis of Betti bases and gem-bisamides from aryl alcohols under solvent-free conditions" by Mr. Balu Gadilohar, Ganapati S. Shankarling\* in CATSCOL-2016.

### PROF. N. SEKAR

- Attended the workshop on Introduction to Gaussian; Theory and Practice at

Delhi, India.

- Attended the International conference on pure and Applied chemistry held in Mauritius and gave an oral presentation on "NLOphoric organicMolecules - structural Diversities" in July 2016.
- Participated in National conference on "Sharing of Innovative ideas andAchievements of centers of Excellence" held at Siddaganga Institute of Technology, Tumakuru, in April 2016.
- Participated in Teaching-Learning Workshop organized by the Institute of Chemical Technology, Matunga, Mumbai under TEQUIP-II in Sept.2016.

### DR. SATYAJIT SAHA

- Teaching and Learning Workshop, ICT Mumbai, 24th Sept, 2016
- NSFAC-2016 Symposia, 13-14th Oct 2016
- Orientation Programme, HRDC, Mumbai University, 5th Jan to 2nd Feb 2017

## EVENTS ORGANIZED:

### PROF. G. S. SHANKARLING:

- "International Symposium on Ionic Liquids"

(ISOIL\_2016) organized in collaboration with Reliance Industries on Jan 21st & 22nd 2016 held at Institute of Chemical Technology, Mumbai.

- Two days' workshop on "Pigment Finishing and Printing Technology" & "Effluent Treatment and Processing", held on 13th & 14th Sept 2016 at Institute of Chemical Technology, Mumbai.

### DR. SATYAJIT SAHA

- Workshop on Pigment Finishing and Printing Technology, Coordinator, ICT Mumbai, 13th Sept, 2016
- Seminar on Effluent Treatment and Processing, Coordinator, ICT Mumbai, 14th Sept, 2016
- COC-2017, Member of the organizing committee, 9th-10th Feb 2017

## INDUSTRIAL CONSULTANCY

### PROF. G. S. SHANKARLING:

- Hindustan Unilever Ltd, Mumbai.
- Jyoti Laboratories, Mumbai.
- Diversey India Pvt. Ltd., Mumbai
- Enviro controls Associates, Surat.



## PASSED OUT STUDENTS

### PH.D. STUDENTS

Name	Course	Title
Haribhau kumbhar	Ph.D.	Synthesis of Novel Fluorescent Organoboron, Styryl and Spiropyran Colorants And Their Applications As Chemosensors.
Vilas Venunath Patil	Ph.D.	Studies on Peroxide Mediated Oxidation Reactions and Synthesis of Novel Coumarin based Colorants.
Balu L. Gadilohar	Ph.D.	Synthesis and Application of Novel Biodegradable Multi Task Specific Ionic Liquids in Organic Synthesis
Pranila Thale	Ph.D.	Magnetic nano heterogeneous catalyst for organic transformation and synthesis of functional colorants
Tayade Rajratna	Ph.D. (SC.)	Synthesis and Application of Fluorescent Colorants Containing Phosphonic Acid Residue
Hanuman Kalmode	Ph.D. (Sc.)	Development of Synthetic Methodologies Leading to Functionalised Chiral Carbocycles, Heterocycles and Imides
Rokade Sunil Manohar	Ph. D (Sc.)	Carbohydrate Chemistry in Deep Eutectic Solvents

### M. TECH. STUDENTS

Name	Course	Title
Rishikant Sonune	M.Tech	Synthesis of azo colourants using deep eutectic solvents
Rohan Kuchekar	M.Tech	Synthesis & application of various aldehydes and their derivatives in perfumery
Anuradha Tawade	M.Tech	Enzymatic synthesis of perfumery and flavour chemicals
Sharvari Desai	M.Tech	Titanium based catalyst for Oxidation Of Industrial Effluent
Priyanka Sagavekar	M. Tech	Oxidative Depolymerization of Lignin into Value Added Products
Ankur Chaturvedi	M. Tech	Studies in nitration and oxidative coupling reactions and isolation of essential oils
Pratik Hande	M. Tech.	Novel Oxidation and Reactive Dyeing Technique
Mr. SathisKumar M	M. Sc. (Madras University)	Synthesis and characterization of monodisperse short chain Poly (ethylene glycol).
Mr. N. Sathis	M. Sc. (Madras University)	Room temperature synthesis and characterization of 4,4'-dihydroxyazobenzene: scope and challenges

## RESEARCH ABSTRACT:

### RESEARCH SCHOLAR:

Mr. Balasaheb Gadilohar

### RESEARCH SUPERVISOR:

Prof.(Dr.) Ganapati Subray Shankarling

### DEGREE AWARDED:

Ph.D. (Science)

**THESIS TITLE:** Synthesis and Application of Novel Biodegradable Multi Task Specific Ionic Liquids in Organic Synthesis

Development of organic reactions in environmental friendly green media (ionic liquids, task specific ionic liquids, deep eutectic solvents etc.) in combination of alternate energy sources (ultrasound, concentrated solar energy, microwave etc.) are the current challenges in the chemical research society and industry. Since last few decade use of task specific ionic liquids (TSILs) in organic reaction has been started, but many TSILs are precarious environmental contaminants<sup>1</sup> and it is necessary to develop alternative TSILs from components that are inexpensive, nontoxic toward the environment, and biodegradable to overcome these drawbacks. Hence, design and synthesis of the new multifunctioning task specific ionic liquids<sup>2</sup> (TSILs) with biodegradable property in combination of alternative renewable energy sources have gained great attention as “green” alternative in green chemistry and technology.

Generally, the chemistry and functionality of these TSILs is

controlled by the choice of the anion, so TSILs polarity can be tuned by a suitable choice of cation/anion using metathesis or ion exchange reaction.<sup>3</sup> Hence, in this project we have designed and synthesized various biodegradable multifunctioning task specific choline based oxidizing ionic liquids<sup>4</sup> and surfactant based TSIL by metathesis reaction effectively as compared to conventionally reported methods.

These TSILs used as reaction medium and catalyst in oxidation<sup>5</sup> reaction, in one pot sequential multicomponent reactions of various heterocycles (such as Betti bases, 5bisamides,<sup>5,4,4'</sup>-diamino-triarylmethanes bis-3,4-dihydropyrimidin-2(1H)-one, hydrazono thiazolyl-pyrazolone) which have high medicinal value.

The chapter 1 is a review of the recent development on choline based TSILs synthesis, characterization and their properties. Chapter 2 deals with the synthesis of various choline based TSILs using metathesis / ion exchange approach and their characterization. Chapter 3 includes the synthesis of bio-TSIL Choline persulfate synthesis, characterization, physico-chemical property study and its application in oxidation of benzyl alcohol to benzaldehyde. Chapter 4 and 5 deals with one pot sequential multicomponent synthesis and characterization of Betti bases (amido alkyl naphthols) and bis-amides respectively using ChPS as triple role player

(oxidant, catalyst and solvent). Chapter 6 discuss synthesis, characterization and application of choline lauryl sulfate as a green surfactant in hydrazono thiazolyl-pyrazolone derivatives synthesis. Biginelli synthesis of bis- 3,4-dihydropyrimidin-2(1H)-one (bis- DHPM)) derivatives from aryl alcohol are studied in chapter 7 using TSIL. Use of alternative energy sources (concentrated solar energy and ultrasound) has been applied for oxidation of benzyl alcohol using biodegradable TSIL Choline peroxydisulfate in chapter 8 and 9. Chapter 10 involve facile one-pot ultrasound assisted synthesis of 4,4'-diamino-triarylmethanes from aryl alcohols using ChBS TSIL and their DFT study

### RESEARCH SCHOLAR:

Mr. Haribhau Kumbhar

### RESEARCH SUPERVISOR:

Prof.(Dr.) Ganapati Subray Shankarling

**DEGREE AWARDED :** Ph.D. (Science)

**THESIS TITLE :** Synthesis of Novel Fluorescent Organoboron, Styryl and

Spiropyran Colorants And Their Applications As Chemosensors

The objective of our work is to design and synthesize solid state fluorescent and aggregation induced emission active organoboron complexes. It also includes design and synthesis of novel spiropyran and styryl dyes based sensors for Cu<sup>2+</sup> ion with colorimetric and fluoregenic detection.

The first chapter starts with a

review of recent trends in the synthesis of fluorescent boron complexes containing tautomeric  $\beta$ -diketone and  $\beta$ -ketoiminate ligands and their applications and then there is a chapter describing synthesis, characterization and photophysical properties of novel benzoxazolyl and benzthiazolyl-1,2-diaryl  $\beta$ -ketoiminate based organoboron complexes. In this, he has studied photoluminescence and electrochemical properties of active  $\beta$ -ketoiminate boron complexes. Chapter 3 and 4 deals with synthesis and fluorescent properties of catechol and salicylate chelated spiroborates respectively. In this, he has examined the effect of electron donating and withdrawing group on the fluorescence and solid state emission of spiroborates. Synthesized spiroborates exhibit its intense solid-state photoluminescence and aggregation induced emission (AIE). Chapter 5 reports the synthesis and spectroscopic study of highly fluorescent  $\beta$ -enaminone based boron complexes. The synthesized  $\beta$ -enaminone boron complexes exhibit intense fluorescence in solution as well as in solid state. These complexes show large stoke shift, excellent thermal and photostability as compared to the boron dipyrromethane (BODIPY) colorants. Chapters 6 includes, aggregation induced emission (AIE) active carbazole styryl luminogens as fluorescent molecular rotors for viscosity sensing. He has successfully synthesized different chemical functionalities at C=C bond and characterized spectroscopically as viscosity sensors. Further, he

has discussed the effect of chemical functionalities/substituents on the fluorescent properties, aggregation induced emission and viscosity sensitivity.

Chapter 7 deals with the aggregation-induced emission (AIE) active benzothiazole and benzoxazole styryl fluorescent molecular rotors as viscosity sensors. The candidate has successfully synthesised novel benzoxazole and benzthiazole based bis and mono-styryl compounds. It also includes, the study of fluorescence properties and molecular rotors properties. He has also discussed the significant enhancement of quantum yield in a viscous solvent. Chapter 8 describes the synthesis and photophysical study of quinaldine-indole based photochromic spiropyrans. He has studied photophysical properties of synthesised compounds by experimental as well as computational means in parallel. The synthesised compounds exhibit good photochromic behaviour and also the effect of chemical functionality on chromene moiety and quinoline-indole on ring opening and closure was studied. Chapter 9 devoted to highly selective quinaldine-indole based spiropyran with intramolecular H-bonding for visual  $\text{Cu}^{2+}$  ion detection. He has developed novel quinaldine-indole based spiropyran (QSP) for colorimetric detection of  $\text{Cu}^{2+}$  ions. The developed chemosensor shows high sensitivity and selectivity for  $\text{Cu}^{2+}$  ions amongst all the tested metal ions. In the last chapter, a highly selective fluorescent chemosensor based on thio- $\beta$ -enaminone

analogue with a turn-on response for Cu (II) ions in aqueous media is synthesized.

#### RESEARCH SCHOLAR:

Mr.Vilas Patil

#### RESEARCH SUPERVISOR:

Prof.(Dr.) Ganapati Subray Shankarling

#### DEGREE AWARDED:

Ph.D. (Science)

#### THESIS TITLE:

Studies on Peroxide Mediated Oxidation Reactions and Studies of Novel Coumarin based Colorants

The aim of this work is to develop selective, mild and efficient protocols for oxidative bromination and oxidation of amines (aromatic as well as aliphatic) using peroxides such as aliphatic diperoxy acids, m-CPBA and hydrogen peroxide. The diperoxy acid used are easy to prepare and handle, non-shock sensitive in nature and stable at room temperature. He has also synthesized novel coumarin based colorants as side chain anchoring group with its application in dye sensitized solar cells & novel styryl dyes possessing two donor and one acceptor groups. The work presented in the thesis includes detailed work of synthesis, characterization and experimental data. The thesis comprises of 10 chapters.

The first chapter deals with a review on synthesis and applications of some widely used important peracids in oxidation reactions. Chapter 2 includes bromination of amino anthracene-9,10-dione using nonanebis(peroxoic acid) as an oxidant has been reported. He

has carried bromination reaction proceeding under mild conditions with high yield and purity which is a good attractive alternative to other conventional peracids. Chapter 3 describes selective oxidative bromination of amino anthraquinone using 50%  $H_2O_2$  and HBr at room temperature. Chapter 4 includes, Bromination of various aminoanthracene-9,10-diones using m-CPBA as a oxidant has been reported. Use of commercially available oxidant, mild reaction conditions, easy work up procedure with high yields of desired products and regio selective bromination of N-alkylated aminoanthracene-9,10-diones are the conspicuous features of present protocol. In chapter 5, he has explained an efficient and transition metal free protocol of oxidation of aromatic amine to nitro functionality. The ortho substituent hindered unusual regio and chemoselective oxidation of aromatic amine in to corresponding nitro compound is described using nonanebis(peroxoic acid). In chapter 6, A selective oxidation of aliphatic amine to oximes using efficient and stable dodecanebis(peroxoic acid) was studied. The nonstock sensitive nature of dodecanebis(peroxoic acid) was confirmed by DSC analysis. chapter 7 describes selective oxidation of aliphatic amine to oxime using m-CPBA in ethyl acetate medium. chapter 8 describes synthesis of 2,3-dihydro-1H-perimidines using Amberlyst 15 as catalyst. The conspicuous features of this protocol are short reaction time, higher product yield, easy

recovery, reusability and regeneration of catalyst. In chapter 9, the candidate has designed and successfully synthesized coumarin based novel sensitizers for Dye Sensitized Solar Cells. It involves synthesis of novel coumarin based colorants with mercapto propionic acid as side chain anchoring group. It was evident that photophysical properties of sensitizer with anchoring group at coumarin ring gives broader absorption from 400 to 550 nm whereas sensitizer with anchoring group at side chain shows comparatively broader absorption from 320 to 600 nm. The synthesized compounds, were characterized by FT-IR,  $^1H$ -NMR,  $^{13}C$ -NMR, mass spectrometry & UV-visible absorption, emission spectra of the synthesized compounds were also recorded. Chapter 10, he has synthesized novel styryl dyes possessing two donor and one acceptor groups.

#### RESEARCH SCHOLAR:

Miss. PRANILA THALE

#### RESEARCH SUPERVISOR:

Prof.(Dr.) Ganapati Subray Shankarling

#### DEGREE AWARDED :

Ph.D. (Science)

**THESIS TITLE:** Magnetic Nano Heterogeneous Catalyst For Organic Transformations and Functional Colorants

The aim of this work is to synthesize magnetite supported nano catalyst and utilize it in various organic transformation. It also includes design and synthesis of novel solid state emissive Boron fluorine complexes. The first Chapter deals with the

review on recent development of magnetic material in the field of catalysis. In this chapter we have discussed various oxidation, hydrogenation, asymmetric and various Carbon-Carbon (C-C) coupling reactions. Chapter 2 and 3 includes synthesis of magnetite supported sulfonic acid nano catalyst  $Fe_3O_4@SiO_2-SO_3H$  and its application for the synthesis of maleimide and phthalimide derivatives. The synthesized catalyst have been fully characterised by various physicochemical methods like IR spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction, dynamic light scattering (DLS), energy dispersive X-ray spectrum and zeta potential measurement techniques. In chapter 4, application of  $Fe_3O_4$  nano particles as a robust, efficient and magnetically recoverable catalyst for transamidation reaction have been mentioned whereas, chapter 5 deals with formylation of amines via transamidation of dimethyl formamide by use of  $Fe_3O_4$  nano catalyst.

Chapter 6 reports the synthesis of novel Boron Fluorine complexes based on maleimide core moiety. To distinguish between the two structural isomer single crystal of one of the isomer is developed and confirmed by single X-ray crystallography data. The synthesized boron complexes exhibits intense fluorescence in solution as well as in solid state. In chapter 7, she has thoroughly studied the photophysical, DFT and electrochemical properties of these dyes and compared with each other. These complexes ex-

hibits large Stoke shift, excellent thermal and photostability as compared to the conventional BODIPY colorants.

In chapter 8 a “turn on” fluorescent and chromogenic chemosensor for fluoride anion detection in acetonitrile as well as in mixed aqueous system. The developed probe shows high sensitivity and selectivity towards fluoride ion. In chapter 9 a complete DFT study of the ligand BTA and its complex BTA.2F is described. The deprotonation mechanism of hydroxide anion and presence of hydrogen bonding of -NH groups with fluoride anion in the ground state have been confirmed by theoretical studies. In the last chapter 10, a highly selective fluorescent probe based on coumarin moiety with a turn-on response for Al (III) ions in aqueous media is developed.

#### RESEARCH SCHOLAR:

Mr. Rishikant Sonune

#### RESEARCH SUPERVISOR:

Prof.(Dr.) Ganapati Subray Shankarling

#### DEGREE

#### AWARDED:

M.Tech

**THESIS TITLE:** Synthesis of azo colourants using deep eutectic solvents

Azo colourants are most important and widely used for various applications. Synthesis of azo colourants using green methodology is gaining huge advantage in dyes industry. In present research work, we have mainly focused on the synthesis of azo colourants using deep eutectic solvent (DES) and we have successfully studied recyclability of the DES for further azo colourants synthesis.

Azo colourant was synthesized using Oxone® as oxidizing agent in DES at room temperature. Deep eutectic solvent was prepared from choline chloride and malonic acid with (1:1) ratio, which was used as a reaction medium as well as catalyst. The DES was prepared and used further for synthesis of azo colourants at room temperature with addition of N-substituted anilines containing electron withdrawing group's presents at the both ends using Oxone® as oxidizing agents, gave azo colourants with good yield (68-75%) in less time.

One pot synthesis of azo colourants using choline chloride: oxalic acid DES at 0-5°C was synthesized. Deep eutectic solvent was prepared from choline chloride and oxalic acid with (1:1) ratio which was used as a reaction medium as well as catalyst. The DES was prepared and used further for synthesis of azo colourants. The reactions were carried out by addition of N-substituted aniline in CHCl<sub>3</sub>: oxalic acid, followed with addition of sodium nitrite and then electron rich coupler at 0-5°C, gave selective azo colourants with excellent yield (90-95%) in short time. The isolated azo colourants were treated with water. DES was recovered and recycled. The crude products were obtained and were further purified using column chromatography. Products confirmations were done with the help of melting point, FTIR, and <sup>1</sup>H-NMR.

The synthesized azo colourants were further applied to poly-

ester fabric using high temperature dyeing method. The dyed fabrics gave excellent washing fastness (30min) results, excellent to very good light fastness (24h) results and excellent heat fastness results at 150°C.

#### RESEARCH SCHOLAR:

Mr. Rohan Kuchekar

#### RESEARCH SUPERVISOR:

Prof. (Dr.) Ganapati Subray Shankarling

#### DEGREE AWARDED: M.Tech

**THESIS TITLE:** Synthesis & application of various aldehydes and their derivatives in perfumery

Fragrances and their various applications permeate our daily lives. On any given day public unconsciously comes in contact with fragrances through various consumer products. Fragrance chemistry is a fascinating blend of natural, synthetic, analytical and physical chemistry with certain amount of creative fantasy, for odors and molecular structures. The condensation of aldehydes with hydroxylamine gives aldoximes, and ketoximes is produced from ketones and hydroxylamine. Oximes are generally used in variety of perfume-containing compositions such as perfume oils, toilet water, cosmetics, creams, soaps, lotions, space deodorants and other deodorants, colognes, detergents, fabric softener etc. The importance of Schiff's bases in perfumery results from fact that they increase both chemical stability and tenacity of aldehyde component. Schiff's bases are less reactive and volatile than free aldehyde. Schiff's bases can be synthesized by condensation

of aldehyde and amine.

**RESEARCH SCHOLAR:**

Miss.Anuradha Tawade

**RESEARCH SUPERVISOR:**

Prof. (Dr.) Ganapati Subray Shankarling

**DEGREE**

M.Tech

**AWARDED:**

**THESIS TITLE:**

Enzymatic synthesis of perfumery and flavour chemicals

The aim of this work is to explore the synthetic utility of enzymes for preparation of perfumery and flavour chemicals. Enzymes are highly active, selective (chemoselective, regioselective, and stereoselective) and they are functional at mild conditions. These factors have favored use of enzymes for synthesis of pure compounds in industry. Enzyme from hydrolases class is studied in this work. Lipase enzyme belonging to hydrolases class has shown its potential in acid catalyzed reactions. This mechanism of lipase enzyme is explored for the synthesis of perfumery and flavour compounds.

Lipase catalyzed synthesis of esters is studied. This reaction is carried out using 10% lipase enzyme in the presence of hexane as solvent at 40-45 °C. Using this protocol, five esters were synthesized and characterized using GC, GC-MS and FT-IR. Good yields were obtained in the range of 75-83%. The same reactions were carried out with immobilized lipase which showed a decrease in reaction time and improved yields. Free lipase was recycled upto 4 runs. Further, lipase catalyzed Knoevenagel condensation was also

studied. The reaction was carried out in the presence of 10% lipase enzyme with ethanol as solvent at 40-45 °C. Using this protocol, four compounds were synthesized and characterized using GC, GC-MS and FT-IR. Yields were obtained in the range of 45-71%. The same reactions were carried out with immobilized lipase which showed a decrease in reaction time and improved yields.

The olfactory properties of all the synthesized compounds were checked by using blotting strips. Amongst them, two derivatives (one from each scheme) having the best odour profiles were chosen for application. Both these derivatives were incorporated in various fragrance formulations and applied in soap, talcum powder, incense sticks and fine fragrance. Flavour application of the chosen ester derivative was also done in muffins and beverages.

The green technique used for synthetic procedures is environmentally benign, less time consuming, safe to handle and also the components used are biodegradable. This procedure using enzymes reported in this work has the potential of application at an industrial scale.

**RESEARCH SCHOLAR:**

Miss Sharvari Desai

**RESEARCH SUPERVISOR:**

Prof. (Dr.) Ganapati Subray Shankarling

**DEGREE AWARDED:**

M.Tech

**THESIS TITLE:**

Novel methods for extraction of perfumery or flavor compounds

The aim of this work is to study the different extraction methods of oil from Buchanania lanzan Spreng.seeds(Chironji seeds). Various extraction methods such as reflux extraction, soxhlet extraction, cold pressing, steam distillation, hydrodistillation, sonication and sonication – assisted extraction were carried out. Percentage yield and odour profile of the chironji oil was compared for different extraction methods. After extraction process the extracted chironji oil has been characterized for its physical and chemical properties. Various physicochemical and phytochemical parameters have been checked and noted. GC, GC-MS and FTIR analysis of the extracted chironji oil have been carried out. Microencapsulation of the extracted chironji oil (cold pressed) by spray drying method was done successfully using mixture of gum Arabic and maltodextrin in combination. Microencapsulation efficiency (ME), particle size analysis, Polydispersity index (PdI) and powder morphology was studied for the encapsulated oil. The application of the encapsulated and non-encapsulated oil was done in skin cream, milk, muffins and chocolate bars and pharmaceutical as well as flavour applications of oil was studied.

**RESEARCH SCHOLAR:**

Miss.Priyanka Sagvekar

**RESEARCH SUPERVISOR:**

Prof. (Dr.) Ganapati Subray Shankarling

**DEGREE AWARDED:**

M.Tech

**THESIS TITLE:**

Oxidative Depolymerization of Lignin into Value Added Products

A novel approach has been developed in order to use kraft lignin as a renewable resource for production of value added chemicals like syringaldehyde, vanillin, acetosyringone and acetovanillone under mild reaction condition. The study is based on utilization of environmentally benign and biodegradable choline persulfate ionic liquid as an oxidant for oxidative depolymerization of kraft hardwood lignin. The choline bisulfate acid catalyst is generated in situ which improves the monomeric product yields. The solvent, temperature and reaction time parameters were optimized. The monomeric product yields were compared with other peracids as oxidant and effect of alkaline pH was studied. Further

the sonication influence was also reported

#### RESEARCH SCHOLAR:

Mr. Ankur Chaturvedi

#### RESEARCH SUPERVISOR:

Prof. (Dr.) Ganapati Subray Shankarling

#### DEGREE AWARDED:

M.Tech

**THESIS TITLE:** Studies in nitration and oxidative coupling reactions and isolation of essential oils

In Chapter 1, 1, 4 Naphthoquinone was nitrated and this reaction was optimized and scaled up. 5- nitro-1,4-Naphthoquinone was readily synthesized from 1,4 Naphthoquinone by using two systems, sodium nitrate in sulfuric acid and mixed acid (sulfuric acid and nitric acid). This reaction is a precursor to the synthesis of Nitro

Anthraquinone, a commercially important dye intermediate. The reaction is easy, short, gives decent yields and has an easy work up procedure.

In Chapter 2 of the work a N, N-dimethyl-indoaniline or Phenol Blue as it is commonly known as was synthesized using a novel, environmentally benign route of synthesis. N,N-dimethylindoaniline or Phenol Blue is an old blue colored dye developed by Germans. Phenol blue is used as a solvatochromic dye in solvent detection probes, and as a cyan coloring agent in colored digital photography.

In Chapter 3 the suitability of the application of a tracked fresnel lens in hydrodistillation of essential oils was studied and such a system was designed and demonstrated to work appreciably well.

## THE DEPARTMENT IS EQUIPPED WITH A FUNCTIONAL ORGANIC SYNTHESIS LABORATORY. FACILITIES INCLUDE:

- Autoclaves, Hastelloy – 300 mL, 1 lit
- Autoclaves, SS 316 – 3 x 600 mL, 5 lit
- Pressure reactor
- Glass assemblies
- Julabo
- Lyophilizer / Freeze dryer
- Ice-Machine
- Oven
- Microwave reactors
- Parr hydrogenators – 300 mL, 600 mL
- Rotary evaporators
- High vacuum pump
- Chemical Vapor Deposition
- Centrifuge Machine
- Ultra Sonicator

## THE FOLLOWING ANALYTICAL INSTRUMENTS ARE AVAILABLE:

- Gas Chromatography (GC)
- HPLC
- FTIR
- UV-Visible Spectrophotometer
- Spectrofluorimetry
- Particle size analyzer
- Simultaneous DSC – TGA i.e. Thermo gravimetric analyzer
- 500 MHz NMR (Sanctioned under Prime Minister's Project).
- Cyclic Voltammetry

## THE PIGMENT HOUSE IS EQUIPPED WITH:

- Analytical mill and homogenizer
- Automatic draw down assembly
- Automatic pigment Mueller
- Automatic vibroshaker
- Ball mill
- Kneader
- Mars mill
- Planetary ball mill
- Sand mill

## LABORATORY PHOTOS:



Agilent 500MHz NMR



Gas Chromatography with Auto-sampler



FTIR-8000 Series JASCO FT-IR Spectrophotometer



Particle size analyzer



Cary Eclipse Fluorescence Spectrophotometer



LAMBDA 25 UV/Vis Spectrophotometer



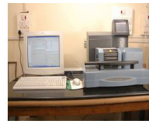
Flash Chromatography Smart Flash EPLC AI-5805 Yamazen



Preparative HPLC



Rotary Evaporator



DSC-TGA Instrument



Lyophiliser

HPLC instrument



Julabo



Cyclic Voltammetry



Chemical Vapor Deposition



Freeze dryer



Centrifuge Machine



Ultra Sonicator



Vaccum oven



Muffle Furnace



## RESEARCH GROUP

### DR. G. S. SHANKARLING RESEARCH GROUP



**First Row (Left to right):** Eknath Gayakwad, Deepak Boraste, Sushil Khopkar, Pritesh Patil, Rishikant Sonune, Prof.G.S. Shankarling, Revathy Nair, Harsha Datey, Manasi Palande, Karishma Shah, Priyanka More.

**Second Row:** Yogesh Patil, Mahesh Jachak, Mekonnen Habtemichael, Saurabh Deshpande, Dharmee Joshi, Jyoti Rathi, Amruta Joglekar, Preeti Pant.

**Third row:** Dr.Haribhau Kumbhar, Viral Mehta, Surabhi Chaudhary.

### PROFESSOR N. SEKAR RESEARCH GROUP



**First Row Left to Right -** Amol Jadhav, Yogesh Erande, Shrikant Thakare, Yogesh Gawale, Prof. N. Sekar, Mayuri Kadam, Supriya Ramugade, Suvidha Shinde, Sulochana Bhalekar.

**Second Row Left to Right-** Manish Raikwar, Dipak Dahatonde, Prashant Mande, Chaitannya Ghanavatkar, Sagar Yadav, Umesh Warade, Dipti lakhe, Nitesh Ayare,

**Third Row Left to Right-** Siddeshwar Jadhav, Santosh Kataria, Dharti Shah, Dhanraj Mohbiya, Dinesh Patil, Ramnath Mallah, Virendra Mishra.

### PROF. P. M. BHATE RESEARCH GROUP



**(L-R)First Row:** Nazim Ahmad, Sunil Rokade (Degree Awarded), Pratik Hande (M.Tech. Completed)

**(L-R)Second Row:** Kamlesh Vadagaonkar, Hanuman Kalmode (Degree Awarded), Professor P. M. Bhat, Vijilata Rajkumari, Ashok Garande

### DR. SURAJIT SOME RESEARCH GROUP



**Centre:** Dr. Surajit Some, **Left:** Dattatray Appasha Pethsangave, **Right:** Pravin Wadeka, **Behind:** Rahul Khose

### DR. SATYAJIT SAHA RESEARCH GROUP



**Left:** Mr. Valmik Pandurang Jejurkar (Ph.D student), **Centre:** Dr. Satyajit Saha,

**Right:** Dr. Rajpratap Kshatriya (Research Associate)