

Shravan Pradeep

Penn Soft Earth Dynamics (PennSED) Group and Complex Fluids Lab, University of Pennsylvania
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EDUCATION & TRAINING

2024-Present	Penn Center for Soft and Living Matter Postdoctoral Fellow Postdoctoral Fellow NSF Engineering Research Center for the IoT for Precision Agriculture
2021-Present	Postdoctoral Researcher Department of Earth and Environmental Science University of Pennsylvania, Philadelphia, PA
2016-2021	Ph.D. in Chemical Engineering <i>Minor</i> : Materials Science and Engineering North Carolina State University, Raleigh, NC
2013-2015	M.S. in Chemical Engineering Birla Institute of Technology and Science (BITS) Pilani, Pilani Campus, India
2008-2012	B.S. in Chemical Engineering First Class with Distinction Amrita Vishwa Vidyapeetham University, Coimbatore, India

RESEARCH INTERESTS

Structured complex fluids, soft particulate mechanics, sustainable manufacturing, soft-living matter interactions, rheology, tribology, confocal microscopy, microfluidics, , and experimental “big data”.

PROFESSIONAL EXPERIENCE

RESEARCH:

2021-Present	Postdoctoral Researcher , University of Pennsylvania, Philadelphia, PA <i>Mentor(s)</i> : Prof. Douglas J. Jerolmack and Prof. Paulo E. Arratia <i>Research Focus</i> : Mechanics of earth-based sustainable soft materials and living matter
Fall 2022	Visiting Affiliate , Kavli Institute of Theoretical Physics (KITP), UC Santa Barbara, CA <i>Program</i> : Multiphase Flows in Geophysics and the Environment
2017-2021	Graduate Research Assistant , North Carolina State University, Raleigh, NC <i>Advisor</i> : Prof. Lilian C. Hsiao <i>Dissertation</i> : Designing flow mechanics in suspensions of surface-anisotropic colloids
2015-2016	Research Assistant , Indian Institute of Technology Delhi, New Delhi, India <i>Advisor(s)</i> : Shalini Gupta, PhD (<i>Current</i> : Founder & CEO at Asima Health Inc., Toronto) <i>Project</i> : Immunomagnetic capture chip development for optical detection of bacteria
2014-2015	Research Assistant , Birla Institute of Technology & Science, Pilani, India <i>Advisor</i> : Sonal Mazumder, PhD (<i>Current</i> : Regulatory Scientist, US-FDA, Silver Springs, MD) <i>Thesis</i> : Quantum dots for photocatalytic degradation of biological pollutants
2011-2012	Research Assistant , Amrita School of Engineering, Coimbatore, India <i>Advisor</i> : Prof. Kanakasabai Panchanathan <i>Senior Project</i> : Titania nanoparticles-embedded polyvinyl alcohol membranes
Summer 2011	Research Intern , Research & Development Establishment (Eng.), Pune, India <i>Advisor</i> : Anoop Anand, PhD (Composite Research Center) <i>Project</i> : Graphene in advanced structural composites

INDUSTRY:

2012-2013	Management Trainee , Mangalore Chemicals & Fertilizers Ltd., Mangalore, India Production Engineering, Ammonia Production Plant
Summer 2010	In-Plant Trainee (Co-Op) , Exide Industries, Hosur, India Industrial Battery Division

AWARDS & HONORS

2024	Penn CSLM Postdoctoral Fellowship , Center for Soft & Living Matter, University of Pennsylvania
2024	APS FECS Mini Grant Recipient , APS Forum for Early Career Scientists
2023	Future Investigator Travel Award , APS Division of Soft Matter
2023	Victor K. LaMer Award Finalist , ACS Colloids and Surface Science Division Postdoctoral Award
2023	Postdoctoral Poster Award - Honorable Mention , APS Forum for Early Career Scientists
2022	Postdoctoral Poster Award - Third Place , Society of Rheology 93 rd Annual Meeting
2022	Summer School Fellowship , University of Colorado, Boulder & National Science Foundation
2022	Diverse Leaders for Future , Future Faculty Workshop Scholar, University of Delaware
2021	James K. Ferrell Outstanding Ph.D. Graduate Award , NC State University
2021	Langmuir Award Finalist , ACS Colloids and Surface Science Division Graduate Student Award
2019	Travel Assistance Award , Graduate Student Association, NC State University
2019	Conference Travel Award , College of Engineering, NC State University
2016-2017	Provost's University Graduate Fellowship , College of Engineering, NC State University
2015	Department 1st Rank , Chemical Engineering Department, BITS Pilani
2015	Poster Award - Second Place , Indian Institute of Chemical Engineers, Pilani Chapter
2012	University 3rd Rank , Amrita Vishwa Vidyapeetham University
2009-2011	School of Engineering Merit Awards , Amrita School of Engineering
2008-2012	Prime Minister's Merit Scholarship , Ministry of Defence, Government of India

JOURNAL PUBLICATIONS

[†]Equal Contribution | Total Publications: 17 | First-Author: 9 | [Google Scholar](#) | [Five Research Highlights](#)

1. **Shravan Pradeep**, Xiangyu Chen, Ali Seiphoori, David R. Vann, Paulo E. Arratia, Douglas J. Jerolmack, “Soft matter mechanics of baseball’s Rubbing Mud”, *Proceedings of the National Academy of Sciences*. *In Press*
[Developed a multiscale mechanical framework to geoinspired sustainable materials design](#)
 - Pre-Publication Highlights: [Philly Inquirer](#) | [Penn News](#)
2. **Shravan Pradeep**, Paulo E. Arratia, Douglas J. Jerolmack, “Origins of complexity in the rheology of Soft Earth suspensions”. *Nature Communications*, 15 (2024). [\[Paper\]](#)
[Discovered a novel material-controlled brittle-ductile transition that connects granular materials to gels](#)
3. Bryan O. Torres Maldonado, **Shravan Pradeep**, Ranjiangshang Ran, Douglas Jerolmack, Paulo E. Arratia, “Sedimentation dynamics of passive particles in dilute bacterial suspensions: emergence of bioconvection”, *Journal of Fluid Mechanics*, 988 (2024). [\[Paper\]](#)
4. Liam Lasting, Mostafa Akbari, Destynn Keuchel, Na Kyung Lee, **Shravan Pradeep**, Shivani Chawla, Abigail Weinstein, Masoud Akbarzadeh, Laia Mogas-Soldevila, “Terrene 2.0: Biomaterial Composites Design and Shellular Structures Optimization for Augmented Earthen Construction”, *Materials and Design*, 239 (2024). [\[Paper\]](#)
5. Ranjiangshang Ran, **Shravan Pradeep**, Sebastien Kosgodagan Acharige, Brendan C Blackwell, Christoph Kammer, Douglas J. Jerolmack, Paulo E. Arratia, “Understanding the rheology of kaolinite clay suspensions using Bayesian inference”, *Journal of Rheology*, 67 (2023). [\[Paper\]](#)
 - Highlight: Editor’s Featured Article
6. Bryan O. Torres Maldonado, Ranjiangshang Ran, K. L. Galloway, Quentin Brosseau, **Shravan Pradeep**, Paulo E. Arratia, “Phase-separation during sedimentation of dilute bacterial suspensions”, *Physics of Fluids*, 34 (2022). [\[Paper\]](#)
7. **Shravan Pradeep**, Paulo E. Arratia, “To biofilm or not to biofilm”, *eLife*, 11 (2022). [\[Insight Article\]](#)
8. Robert Kostynick[†], Hadis Matinpour[†], **Shravan Pradeep**[†], Thomas Dunne, Sarah Haber, Alban Sauret, Eckart Meiburg, Paulo E. Arratia, Douglas J. Jerolmack, “Rheology of debris flows controlled by the distance from jamming”, *Proceedings of the National Academy of Sciences USA*, 119 (2022). [\[Paper\]](#)
[Examined material failure using suspension rheology framework to improve hazard prediction models](#)
 - Highlights: Physics of disaster: How mudslides move. [NSF News](#) | [Penn News](#) | [AAAS EurekAlert!](#)

9. **Shravan Pradeep**, Alan Wessel, Lilian C. Hsiao, “Hydrodynamic origin for the suspension viscoelasticity in rough colloids”, *Journal of Rheology*, 66 (2022). [\[Paper\]](#)
Uncovered enhanced particle surface anisotropy-controlled material elasticity in dense colloidal suspensions
 - **Highlight:** Editor’s Featured Article
10. Zijian Dai, **Shravan Pradeep**, Jie Zhu, Wenyi Xie, Heather F. Barton, Yang Si, Bin Ding, Jianyoung Yu, Gregory Parsons, “Freestanding metal organic framework-based microfiltration membranes fabricated *via* pseudo-morphic replication toward liquid- and gas hazards abatement”, *Advanced Materials Interfaces*, 8 (2021). [\[Paper\]](#)
11. **Shravan Pradeep**, Mohammad Nabizadeh, Alan R. Jacob, Safa Jamali, Lilian C. Hsiao, “Jamming distance dictates colloidal shear thickening”, *Physical Review Letters*, 127 (2021). [\[Paper\]](#)
Reported the first experimental 3D contact network microstructure in shear thickening complex fluids
 - **Highlights:** New images lead to better prediction in shear thickening. [Phys.Org](#) | [NC State News](#)
12. Jie Zhu, Weiwang Qiu, Hua Han, Chengjian Yao, Chun Wang, Dequn Wu, **Shravan Pradeep**, Zijian Dai, “Water stable UiO-66-NH₂ metal organic frameworks armed poly(vinyl) alcohol nanofibrous wound dressing with anti-infective therapy”, *Journal of Colloid and Interface Science*, 603 (2021). [\[Paper\]](#)
13. **Shravan Pradeep**, Lilian C. Hsiao, “Contact criterion in suspensions of smooth and rough colloids”, *Soft Matter*, 16 (2020). [\[Paper\]](#)
14. Lilian C. Hsiao, **Shravan Pradeep**, “Experimental synthesis and characterization of frictional particles for colloidal and granular rheology”, *Current Opinion in Colloid and Interface Science*, 43 (2019). [\[Paper\]](#)
15. **Shravan Pradeep**, Sai Raghuram, Sonal Mazumder, “Rapid synthesis of pure and doped ZnS quantum dots for photocatalytic degradation of biological dye pollutants”, *Materials Focus*, 6 (2017). [\[Paper\]](#)
16. **Shravan Pradeep**[†], Sai Raghuram[†], Mahua Chaudhury, Sonal Mazumder, “Synthesis and characterization of Fe³⁺ and Mn²⁺ doped ZnS quantum dots for photocatalytic application: Effect of mercaptoethanol and chitosan as capping agent”, *Journal of Nanoscience and Nanotechnology*, 17 (2017). [\[Paper\]](#)
17. Sai Raghuram, **Shravan Pradeep**, Subhra Dash, Rajdeep Chowdhury, Sonal Mazumder, “Chitosan encapsulated ZnS:M (M: Fe³⁺ and Mn²⁺) quantum dots for fluorescent labelling of sulphate reducing bacteria”, *Bulletin of Materials Science*, 39 (2016). [\[Paper\]](#)

In Preparation:

- **Shravan Pradeep**[†], Nandish Vora[†], Ranjiangshang Ran, Paulo E. Arratia, “Stretching field statistics in time-periodic flows with dilute bacterial suspensions”.
- **Shravan Pradeep**, Albane Thery, Paulo E. Arratia, Douglas Jerolmack, “Unified rheology framework for particulate suspensions yielding under shear”.
- **Shravan Pradeep**, Bryan O. Torres Maldonado, Paulo E. Arratia, “Velocity fluctuations in sedimentation of particles stirred by bacterial suspensions”.

TEACHING EXPERIENCE & CERTIFICATIONS

Teaching Assistant & Guest Lecturer, University of Pennsylvania

Department of Mechanical Engineering & Applied Mechanics | Department of Earth & Environmental Science

- MEAM 202 Introduction to Thermo-Fluids Engineering Fall 2024, Fall 2023, Fall 2022
- MEAM 225 Engineering in the Environment Spring 2024, Spring 2022
- MEAM 5360 Viscous Fluid Flows and Modern Applications Spring 2024
- EESC 6720 Landslides - Granular Matter Failure Modes Spring 2022

Teaching Assistant, North Carolina State University

Department of Chemical and Biomolecular Engineering

- CHE 713 Chemical Engineering Thermodynamics Fall 2019
- CHE 205 Chemical Process Calculations Fall 2017
- CHE 312 Transport Processes II Spring 2017

Teaching Assistant, Birla Institute of Technology and Science Pilani

Department of Chemical Engineering

- CHE F312 Chemical Engineering Lab I (Transport Phenomena) Fall 2014, Fall 2013
- CHE F322 Chemical Engineering Lab II (Chemical Kinetics & Process Control) Spring 2015, Spring 2014

MENTORING EXPERIENCE

University of Pennsylvania

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|---------------|---|
| Graduate | Julia Radzio (Ph.D. Mechanical) <i>Project</i> : Microfluidics-mediated extensional rheometry |
| | Bryan Maldonado (Ph.D. Mechanical) <i>Project</i> : Sedimentation in bacterial suspensions |
| | John Ruck (Ph.D. Geophysics) <i>Project</i> : Intrusion dynamics in granular media |
| | Nandish Vora (Ph.D. Physics) <i>Project</i> : Chaotic mixing dynamics stirred by bacterial activity |
| | Lidan Gou (M.S. Chemical) <i>Project</i> : Tribology of bacterial biofilms |
| Undergraduate | Xiangyu Chen (B.S. Mechanical) <i>Project</i> : Soft tribology of baseball's Rubbing Mud |
| | Eric Sigg (B.S. Mechanical) <i>Project</i> : Analogs for ocean floor granular failure dynamics |
| Summer REU | Ivanellys Tirado (IoT4Ag) Program <i>Project</i> : Complex fluid flow in branched networks |
| | Alan Gao (Penn VIPER Program) <i>Project</i> : Moisture sensing in living porous media |

North Carolina State University

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| Undergraduate | Alan Wessel <i>Project</i> : Linear viscoelasticity in rough colloidal suspensions |
| (B.S. Chemical) | Sara Wozniak <i>Project</i> : Contact number estimation from colloidal microstructure |
| | Christine Dang <i>Project</i> : Synthesis and characterization of rough colloidal particles |
| | Colin Donaldson <i>Project</i> : Synthesis and characterization of aqueous colloidal particles |
| | Alex Kramer <i>Project</i> : Synthesis and characterization of double emulsions |

PROFESSIONAL ACTIVITIES, SERVICE & OUTREACH

Academic Peer-Review:

- *Grant Proposal*: NASA (online panelist and *ad-hoc* reviewer)
- *Journals*: Nature Communications, Physical Review Letters, Journal of Colloid & Interface Science, Journal of Rheology, Geophysical Research Letters, Physical Review E, Rheologica Acta, and others.
- *Conference Session*: AAAS Annual Meeting Scientific Session

Conference Chair/Co-Chair:

- American Institute of Chemical Engineers Annual Meeting
 - *Session*: Nonlinear Flows and Combined Transport Processes 2024
- American Physical Society March Meeting
 - *Session*: Soft Earth Geophysics 2024
 - *Session*: Functionality through Nonlinearity in Metamaterials 2023
 - *Session*: Rheology, Flow & Instabilities of Soft Materials 2022
 - *Session*: Interfaces and Mixing & Kandanoff Prize Talk 2022
- Society of Rheology Annual Meeting
 - *Session*: Colloids and Suspensions 2022

University & Scientific Community Service and Science Outreach:

- *Science Instructor*, Skype-a-Scientist (Non-Profit), Philadelphia 2023-Present
- *Poster Session Judge*, Society of Rheology Annual Meeting 2024
- *Membership Committee*, Division of Soft Matter (DSOFT), American Physical Society 2024
- *Session Organizer*, Soft Earth Geophysics - DSOFT Focus Session, APS March Meeting 2024
- *Poster Session Judge*, Materials Engineering & Sciences Division, AIChE Annual Meeting 2023
- *Student Activities Committee*, Division of Soft Matter (DSOFT), American Physical Society 2019-2022
- *Captain*, Graduate Recruitment Event, Chemical & Biomolecular Engineering, NC State 2019
- *Student Organizer*, Future Leaders in Chemical Engineering, NC State 2018, 2019
- *Vice-President*, Chemical & Biomolecular Engg. Graduate Student Association, NC State 2017-2018
- *Student Senate Member*, Academic Counselling Cell, BITS Pilani 2014-2015

Diversity, Equity, and Inclusion Activities:

- *Mentor*, IoT4Ag Pathway to PhD Program, University of Pennsylvania 2024
- *Admissions Committee*, Diversity Equity Engagement at Penn (DEEPenn) in STEM Event 2024
- *Postdoc Rep*, Climate, Diversity, Equity & Inclusion Committee (CDEIC), UPenn 2022-Present
- *Volunteer Staff*, Diversity Equity Engagement at Penn (DEEPenn) in STEM Event 2022, 2023
- *Mentor*, Alumni Mentoring Program, Chemical & Biomolecular Engineering, NC State 2021-2022

Professional Member: American Institute of Chemical Engineers (AIChE), American Society of Mechanical Engineers (ASME), Society of Rheology (SOR), American Chemical Society (ACS), American Physical Society (APS), American Geochemical Society (AGS), and American Geophysical Union (AGU).

SCIENTIFIC PRESENTATIONS

INVITED TALKS:

1. **Shravan Pradeep**, “Soft matter mechanics framework for engineering sustainable geomaterials”, Session: Rheology and Flow of Soft Materials”, *APS Global Physics Summit*, Anaheim, CA (2025).
2. **Shravan Pradeep**, “Engineering earth-inspired hierarchical soft materials”, *Soft, Fluid, and Living Matter (SoFLivMat) Seminar Series*, Yale University, New Haven, (2024).
3. **Shravan Pradeep**, “Rheological signatures of yielding in model Soft Earth suspensions”, *Future of Rheology*, Society of Rheology Virtual Seminar Series (2024).
4. **Shravan Pradeep**, “Frictional interactions anneal yielding dynamics in suspensions”, *ACS Colloids and Surface Science Symposium*, Raleigh, NC (2023). LaMer Award (Colloids Early Career) Keynote Speaker
5. **Shravan Pradeep**, “Material constraints dictate flow mechanics in dense suspensions”, Session: Frontiers in Soft Matter, *APS March Meeting*, Las Vegas, NV (2023). Invited Soft Matter Postdoctoral Scholars Session
6. **Shravan Pradeep**, “Distance to jamming dictate colloidal shear thickening”, *The Plot Thickens*, Shear Thickening Virtual Seminar Series (2021).
7. **Shravan Pradeep**, “Probing contact microstructure in shear thickening colloidal suspensions”, *ACS Colloids and Surface Science Symposium*, Virtual (2021). Langmuir Graduate Student Speaker

ORAL PRESENTATIONS (Selected):

1. Shravan Pradeep, Paulo Arratia, Douglas Jerolmack, “Ductile-to-brittle transition in Soft Earth particulate systems”, *Society of Rheology Annual Meeting*, Austin, TX (2024).
2. **Shravan Pradeep**, Xiangyu Chen, Paulo Arratia, Douglas Jerolmack, “Rheo-Tribological Origins of Baseball *Magic Mud* Mechanics”, *ACS Colloids and Surface Science Symposium*, Seattle, WA (2024).
3. **Shravan Pradeep**, Paulo Arratia, Douglas Jerolmack, “Rheological fingerprints of soft earth suspensions”, *APS March Meeting*, Minneapolis, MN (2024).
4. **Shravan Pradeep**, “Soft Soil Mechanics: Discovering rheological constitutive models via. Soft Earth Geophysics”, *Mid-Atlantic Soft Matter Workshop*, Georgetown University, Washington D.C. (2024).
5. **Shravan Pradeep**, Paulo Arratia, Douglas Jerolmack, “Rheological fingerprints of non-inertial debris flows”, *Annual Meeting of the APS Division of Fluid Dynamics*, Washington, DC (2023).
6. **Shravan Pradeep**, Paulo Arratia, Douglas Jerolmack, “Less is more: *Simple* complex fluids reveal rheological fingerprints in environmental flows”, *AIChE Annual Meeting*, Orlando, FL (2023).
7. **Shravan Pradeep**, Eckart Meiburg, Paulo Arratia, Douglas Jerolmack, “Rheological flow curves for model earth suspension mixtures”, *Society of Rheology Annual Meeting*, Chicago, IL (2022).
8. **Shravan Pradeep**, Robert Kostynick, Thomas Dunne, Paulo Arratia, Douglas Jerolmack, “Constraint-based approach towards debris flow rheology”, *APS March Meeting*, Chicago, IL (2022).
9. **Shravan Pradeep**, Alan Wessel, Lilian Hsiao, “Elucidating the effect of surface roughness-induced geometric frustration on linear viscoelasticity in colloids suspensions”, *APS March Meeting*, Chicago, IL (2022).

10. **Shravan Pradeep**, Alan Wessel, Lilian Hsiao, "Effect of geometric frustration on the linear viscoelasticity in dense colloidal suspensions", *Society of Rheology Annual Meeting*, Bangor, ME (2021).
11. **Shravan Pradeep**, Alan Jacob, Lilian Hsiao, "Distance to jamming dictates onset stress and strength of shear thickening", *International Congress on Rheology*, Virtual (2020). Keynote Speaker - Colloids, Suspensions, and Granular Media Session
12. **Shravan Pradeep**, Alan Jacob, Lilian Hsiao, "Universal correlation between jamming distance and shear thickening strength in dense colloidal suspensions", *Annual Meeting of the APS Division of Fluid Dynamics*, Virtual (2020).
13. **Shravan Pradeep**, Lilian Hsiao, "Contact numbers and radial distributions in suspensions of smooth and rough colloids", *APS March Meeting*, Boston, MA (2019).

POSTER PRESENTATIONS (Selected):

1. **Shravan Pradeep**, Xiangyu Chen, Paulo Arratia, Douglas Jerolmack, "Baseball gripping mechanics as a multiscale soft matter problem", *International Soft Matter Conference*, Raleigh, NC (2024).
2. **Shravan Pradeep**, Paulo Arratia, Douglas Jerolmack, "Unifying yielding mechanics in multiphase soft particulate matter systems", *International Soft Matter Conference*, Raleigh, NC (2024).
3. **Shravan Pradeep**, Paulo Arratia, Douglas Jerolmack, "Rheological toolkit for multiphase soft matter manufacturing", *Princeton Advanced Manufacturing Symposium*, Princeton University, Princeton, NJ (2024).
4. **Shravan Pradeep**, Lilian Hsiao, Paulo Arratia, Douglas Jerolmack, "Jamming distance: physics-informed design parameter for dense suspension rheology", *APS March Meeting*, Las Vegas, NV (2023). APS Forum for Early Career Scientists Poster Award - Honorable Mention
5. **Shravan Pradeep**, Robert Kostynick, Hadis Matinpour, Sarah Haber, Alban Sauret, Eckart Meiburg, Thomas Dunne, Paulo Arratia, Douglas Jerolmack, "Jamming distance controls rheology of debris flows", *KITP Conference: Multiphase Flows Atmospheres, Oceans, Earths*, Santa Barbara, CA (2022).
6. **Shravan Pradeep**, Lilian Hsiao, "Engineering flow mechanics in dense suspensions of surface-anisotropic colloids", *Society of Rheology Annual Meeting*, Chicago, IL (2022). Poster Award - Third Place
7. **Shravan Pradeep**, Robert Kostynick, Hadis Matinpour, Sarah Haber, Alban Sauret, Eckart Meiburg, Thomas Dunne, Paulo Arratia, Douglas Jerolmack, "Yield, jam, and flow: Unpacking physics of debris flows", *Gordon Research Seminar: Granular Matter*, Boston, MA (2022).
8. **Shravan Pradeep**, Lilian Hsiao, Towards designing flow mechanics in dense suspensions, *Triangle Soft Matter Workshop*, Virtual (2021).
9. **Shravan Pradeep**, Lilian Hsiao, "Geometric frustration-induced phase behavior in spherically symmetric colloids", *AIChE Annual Meeting*, Virtual (2020).
10. **Shravan Pradeep**, Yunhu Peng, Lilian Hsiao, "Connecting frictional dissipation to rheology of confined suspensions", *Society of Rheology Annual Meeting*, Raleigh, NC (2020).
11. **Shravan Pradeep**, Alex Kramer, Lilian Hsiao, "Programmable self-assembly and suspension rheology in light-responsive colloidal systems", *ACS Colloids & Surface Science Symposium*, State College, PA (2018).
12. **Shravan Pradeep**, Sai Raghuram, Sonal Mazumder, "Synthesis and characterization of Fe^{3+} and Mn^{2+} doped ZnS nanocrystals", *Workshop on Analytical Instruments for Chemical & Environmental Engineers*, Pilani, India (2015). Poster Award - Second Place