

SANKET BISWAS

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Education

The University of British Columbia, Vancouver, BC, Canada

Master of Applied Science (MSc) in Chemical & Biological Engineering

Sep. 2023 – Present

GPA: 96.5%

– Advisors: Prof. John M. Frostad and Prof. Gwynn J. Elfring

– Thesis: Dynamics and Rheology of Viscoelastic Microdroplets Under Oscillatory and Quasi-Static Compression.

– Mitacs Globalink Graduate Fellowship Award (CA\$15,000), Mitacs, 2023-24.

Sant Longowal Institute of Engineering and Technology, PB, India

Bachelor of Engineering with Honors (BE Hons.) in Chemical Engineering

Aug. 2019 – May 2023

GPA: 9.39/10

– University Rank 2, Department Rank 1

– Thesis (at Indian Institute of Science): Dynamics of Inertial Active Brownian Particles in a Microchannel with Poiseuille Flow.

– IICHE Research Award (INR 10,000), best BE thesis, Indian Institute of Chemical Engineers (IICHE), 2023.

– Mitacs Globalink Research Internship (CA\$4,400), University of Waterloo, 2022.

Research Interests

I am interested in utilizing **applied mathematics**—typically asymptotic analysis, vector calculus, partial differential equations (PDEs), and variational calculus—along with **computational modeling** and **table-top experiments** to study **transport processes** and rheology in active and soft matter, biofluids, complex fluids, and interfacial phenomena.

Research Experience

MSc Thesis (funded by NSERC, Tri-Agency, and Mitacs)

Sep. 2023 – Present

University of British Columbia

Advisors: Prof. John Frostad and Prof. Gwynn Elfring

Topic: Dynamics and Rheology of Viscoelastic Microdroplets Under Oscillatory and Quasi-Static Compression. [Presentation](#)

– Project 1: Utilized the **Maxwell linear viscoelastic model** and **lubrication theory** to derive the force response of a viscoelastic microdroplet under small-amplitude oscillatory compression between two closely spaced plates in an ambient Newtonian fluid.

– Designed an **experimental framework** to decouple the droplet's interfacial tension, storage modulus, and loss modulus using the *Cantilevered Capillary Force Apparatus (CCFA)*. Work accepted at **2024 APS DFD** and **manuscript in preparation** for submission to *Physical Review Fluids*.

– Currently solving for the ambient **Stokes flow field** and extending this analytical model to account for a **surfactant-laden interface**.

– Project 2: Derived **second-order accurate asymptotic expansions** for the force response and shape function of a microdroplet undergoing small quasi-static displacements from equilibrium under 3 constant constraints: (a) bridge volume, (b) bridge mean curvature, and (c) droplet volume.

Validated the approximations using **Python-based RK45 numerical frameworks** with **adaptive step sizing**. Work submitted to **2025 APS March Meeting**, and **manuscript in preparation** for submission to *Langmuir*. Extending the model to incorporate **interfacial rheology**.

Term Project 2

Jan. 2024 – Apr. 2024

Advisor: Prof. Anthony Wachs

University of British Columbia

Topic: Dynamics of Oscillatory Squeeze Flow (OSF) in Newtonian Fluids. [Report](#), [Presentation](#)

– Developed **second-** and **fourth-order** accurate **finite difference** schemes in **Python** to compute the flow field and force response of Newtonian droplets under OSF at high Capillary numbers.

– Validated the numerical scheme in the small-amplitude strain limit by deriving **analytical expressions** for the flow field and force response.

Term Project 1

Jan. 2024 – Apr. 2024

Advisor: Dr. Alec Jameson

University of British Columbia

Topic: Interfacial Effects in Oscillatory Squeeze Flow Rheometry. [Report](#)

– Partnered with a fellow group member to conduct a comprehensive **literature survey** on the influence of interfacial tension, surfactants, and contact angle hysteresis on OSF dynamics at both high and low capillary numbers.

Undergraduate Thesis

Jan. 2023 – May 2023

Advisors: Prof. Shubhadeep Mandal and Prof. Aloke Kumar

Indian Institute of Science (IISc)

Topic: Dynamics of Inertial Active Brownian Particles (ABPs) in a Microchannel with Poiseuille Flow. [Thesis](#), [Presentation](#)

– Derived the governing stochastic differential equations for the **2D trajectories** of **inertial ABPs** in a rectangular microchannel with Poiseuille flow using **Langevin equations**. Designed and implemented a **second-order accurate stochastic finite difference scheme** with reflective boundaries in **MATLAB** to solve these equations.

– Analyzed ABP trajectories and **phase spaces** using **mean squared displacement**, **velocity autocorrelation function**, and **joint probability distribution function**, to assess the influence of particle inertia, local fluid temperature, flow speed, and initial conditions.

Undergraduate Hons. Project

Jan. 2023 – May 2023

Advisor: Prof. Shubhadeep Mandal

Indian Institute of Science (IISc)

Topic: Simulation of a 2D Squirmer in a Rectangular Microchannel. [Report](#), [Presentation](#)

– Designed and validated a **COMSOL simulation framework** to study the impact of channel height on the dynamics of a **2D squirmer** in quiescent Newtonian fluid within a 2D rectangular microchannel.

Undergraduate Minor Project

Sep. 2022 – Dec. 2022

Advisor: Prof. Kamlesh Kumari

Sant Longowal Institute of Engineering and Technology (SLIET)

Topic: Rheological Analysis of Drilling Fluids using the Marsh Funnel. [Preprint](#), [Presentation](#)

- Used the **Herschel-Bulkley model** to derive analytical expressions for the flow rate, exit velocity, and rheological properties of drilling fluid flowing through a Marsh funnel under the influence of gravity.
- Utilized the model to **experimentally** determine the rheological properties of 12 drilling fluids, achieving an **average error of less than 5%**, a level of accuracy not previously attained.

Mitacs Globalink Research Internship

Jun. 2022 – Aug. 2022

Advisor: Prof. Benoit Charbonneau

University of Waterloo

Topic: Packing of n -Dimensional Space with n -Dimensional Non-Spherical Symmetric Convex Bodies. [Presentation](#)

- Partnered with a fellow Mitacs participant to perform an extensive **literature review** on **optimal packings and coverings** of \mathbb{R}^n with spheres, polyhedrons, and ellipsoids.
- Designed and implemented an **exact non-linear programming model** based on **Monte Carlo methods** in **Maple** to determine tight bounds for the densest packing of \mathbb{R}^n with congruent n -dimensional ellipsoids. Presented the results at the **2022 Canadian Undergraduate Mathematics Conference**.

Semester Project 3 [Virtual]

Jan. 2022 – May 2022

Advisor: Prof. Sumesh Thampi

Indian Institute of Technology Madras

Topic: Confinement-Induced 3D Trajectories of Microswimmers in Rectangular Microchannels.

- Modeled the **microswimmer** as a **squirmer** and derived analytical expressions for its **3D trajectories** in rectangular microchannels by applying **far-field approximations** and the **method of images**. Investigated how the trajectories varied with the strength and size of the squirmer, confinement dimensions, and initial conditions.
- Validated the analytical findings by designing and implementing a **lattice-Boltzmann method (LBM)**-based numerical framework in **MATLAB**, incorporating a **mid-grid bounce-back scheme** for the squirmer's velocity on the surface.

Semester Project 2 [Virtual]

Sep. 2021 – Dec. 2021

Advisors: Prof. S. Chernyshenko and Prof. G. Fantuzzi

Imperial College London

Topic: Nonlinear Stability Analysis of Fluid Flows using Semi-Algebraic Optimization.

- Implemented the method of **sum-of-squares optimization** to construct **Lyapunov functions** in **MATLAB** and established the **nonlinear stability** of a **rotating Couette flow** at Reynolds numbers about seven times higher than those achievable using standard energy stability methods.

Research Experiences for Undergraduates (REU) [Virtual]

Jun. 2021 – Aug. 2021

Advisor: Prof. Juliette Bruce

University of California, Berkeley

Topic: Abelian Varieties and Subcomplexes of Perfect Chain Complexes.

- Teamed up with two fellow REU participants to investigate the perfect chain complex of **polyhedral cones** by analyzing the subcomplexes associated with graphic and co-graphic matroids, contributing to a deeper understanding of their **topological properties**.

Semester Project 1 [Virtual]

Jan. 2021 – May 2021

Advisor: Prof. Nishad Kothari

Indian Institute of Technology Madras

Topic: Strengthening Petersen's Theorem: Investigating Perfect Matchings in Bridgeless Cubic Graphs.

- Collaborated with a fellow group member to strengthen Petersen's Theorem on **perfect matchings** in **bridgeless cubic graphs** by proving that each edge in these graphs is part of at least two distinct perfect matchings, except for specific special graphs and infinite families.

PROMYS Research Lab [Virtual]

Jun. 2020 – Aug. 2020

Advisor: Prof. Kiran kedlaya

Boston University

Topic: Ehrhart-Equivalence, Equidecomposability, and Unimodular Equivalence of Integral Polytopes. [Preprint](#)

- Partnered with five fellow PROMYS attendees to establish **6 theorems** determining Ehrhart-equivalence between two integral n -polytopes in \mathbb{R}^n .

Awards, Fellowships, and Honors

- International Tuition Award (CA\$6,400), Faculty of Graduate Studies, **University of British Columbia**, 2023-25.
- Mitacs Globalink Graduate Fellowship Award (CA\$15,000), **Mitacs**, 2023-24.
- Faculty of Applied Science Graduate Award (CA\$5,000), **University of British Columbia**, 2023-24.
- Biophysics Summer Internship (€3,650), Max Planck Institute for the Physics of Complex Systems (MPI-PKS), 2023.
- JNCASR Summer Research Fellowship Program (INR 20,000), Indian Institute of Science (IISc), 2023.
- IICChE Research Award (INR 10,000), best BE thesis, Indian Institute of Chemical Engineers (IICChE), 2022-23.
- Mitacs Globalink Research Internship (CA\$4,400), Faculty of Mathematics, **University of Waterloo**, 2022.
- Research Experiences for Undergraduates (REU), Department of Mathematics, **University of California, Berkeley**, 2021.
- Mehta Fellowship (US\$7,630), Program in Mathematics for Young Scientists (PROMYS), Boston University, 2019 & 2020.
- Mathematics Summer Program (€1,000), École normale supérieure (ENS), Paris, 2018.
- Qualified Indian National Mathematics Olympiad (INMO), Tata Institute of Fundamental Research (TIFR), 2016.
- High Distinction in Australian Mathematics Competition (AMC), Australian Maths Trust, 2016.

Scholarly Contributions

For a curated list of **conference** and **seminar** presentations, **preprints**, **manuscripts** under preparation, and other scholarly work, please visit: [Scholarly Contributions](#).

Teaching Experience

Graduate Teaching Assistant	CHBE 230 - Computational Methods	2024-25 Winter Term 2, UBC
	CHBE 251 - Transport Phenomena I	2024-25 Winter Term 2, UBC
	CHBE 352 - Transport Phenomena II	2024-25 Winter Term 1, UBC

Responsibilities: Weekly lectures, tutorials, preparing and marking assignments and exams, one-on-one discussions during office hours.

Selected Coursework

Graduate Courses ([Transcript](#))

Core	Fluid Mechanics, Numerical Methods, Transport Phenomena.
Specialized	Interfacial Phenomena, Complex Fluids#.
Advanced	Asymptotic Analysis & Perturbation Methods, Calculus of Variations#.

Undergraduate Courses ([Transcript](#))

Core	Fluid Mechanics, Heat Transfer, Mass Transfer, Transport Phenomena, Engineering Mathematics, Numerical & Statistical Methods, Chemical Engineering Thermodynamics, Chemical Reaction Engineering, Process Instrumentation & Control.
Specialized	Modelling & Simulation, Polymer Science & Engineering.
Advanced	Computational Transport Phenomena, Microhydrodynamics#, Statistical Mechanics#, Dynamical Systems#, Biophysics#, Biofluid Dynamics#, Optimization of Chemical Processes, Process Equipment Design, Process Energy Integration.
Electives	Design & Analysis of Algorithms#, Computer Graphics, Software Reliability & Testing, Structural Graph Theory#, Convex Optimization#, Algebraic Complexity Theory#.

= audited.

Technical Skills

- Programming Languages:** C++, Haskell, MATLAB, Python, SQL
- Scientific Tools:** COMSOL, Inkscape, Maple, PlotDigitizer, SageMath, Wolfram Mathematica
- Typesetting Tools:** L^AT_EX, Overleaf, TeXShop, IguanaTeX
- Development Tools:** GitHub, JupyterLab, Spyder

Positions of Leadership and Mentorship

- Captain, CHBE GSC Soccer/Futsal Team, UBC, 2023-Present:** Led and managed my department's **mixed-gender** soccer/futsal team to a **championship** title in the UBC Soccer Championship and a **second-place** finish in the UBC Futsal League.
- Mitacs Globalink Ambassador, Mitacs, 2023:** Provided guidance and assistance to incoming Mitacs Globalink Research Internship fellows, addressing their queries about the host city, research projects, and related topics.
- Advisor & Ex-Coordinator, IIChe Student Chapter, SLIET, 2021-Present:** Spearheaded the foundation and coordination of the [IIChe Lecture Series](#), a platform for **undergraduates across India** to engage with **cutting-edge research** in Chemical Engineering and related fields through distinguished speakers from academia and industry worldwide.
- Mentor, Student Mentor Scheme, SLIET, 2020-Present:** Mentored **12 undergraduates** at SLIET, guiding them to **prestigious research internships** both in India and abroad. Mentoring 5 students in 2024-25.
- Junior Counsellor, PROMYS, Boston University, 2020:** Graded daily problem sets, provided guidance, and organized social activities for a cohort of **60 exceptional high school math geniuses** from **across the US** at PROMYS.

Professional Memberships

- American Physical Society (APS) Division of Fluid Dynamics (DFD) and Division of Soft Matter (DSOFT)
- American Institute of Chemical Engineers (AIChE)
- Pacific Institute for the Mathematical Sciences ([PIMS](#))
- UBC Institute of Applied Mathematics ([IAM](#))
- UBC Physics And Computation, Mathematics And Numerics ([PACMAN](#)) Group
- Indian Institute of Chemical Engineers ([IIChe](#))
- PROMYS Alum Community