

# SANKET BISWAS

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## Education

**The University of British Columbia, Vancouver, BC, Canada**

Sep. 2023 – Present

*Master of Applied Science (MAsc) in Chemical & Biological Engineering*

**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**

Aug. 2019 – May 2023

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

**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.
- IChE Research Award (INR 10,000), **best BE thesis**, Indian Institute of Chemical Engineers (IChE), 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

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

Sep. 2023 – Present

**Advisors:** [Prof. John Frostad](#) and [Prof. Gwynn Elfring](#)

**University of British Columbia**

**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.
- [IChE Research Award](#) (INR 10,000), **best BE thesis**, **Indian Institute of Chemical Engineers (IChE)**, 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
	<b>Responsibilities:</b> 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 <sup>#</sup> .
Advanced	Asymptotic Analysis & Perturbation Methods, Calculus of Variations <sup>#</sup> .

### 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 <sup>#</sup> , Statistical Mechanics <sup>#</sup> , Dynamical Systems <sup>#</sup> , Biophysics <sup>#</sup> , Biofluid Dynamics <sup>#</sup> , Optimization of Chemical Processes, Process Equipment Design, Process Energy Integration.
Electives	Design & Analysis of Algorithms <sup>#</sup> , Computer Graphics, Software Reliability & Testing, Structural Graph Theory <sup>#</sup> , Convex Optimization <sup>#</sup> , Algebraic Complexity Theory <sup>#</sup> .

<sup>#</sup> = audited.

## Technical Skills

- **Programming Languages:** C++, Haskell, MATLAB, Python, SQL
- **Scientific Tools:** COMSOL, Inkscape, Maple, PlotDigitizer, SageMath, Wolfram Mathematica
- **Typesetting Tools:** L<sup>A</sup>T<sub>E</sub>X, 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, IChE Student Chapter, SLIET, 2021-Present:** **Spearheaded** the foundation and coordination of the *IChE 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 ([IChE](#))
- [PROMYS Alum Community](#)