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# Notice for the PhD Viva Voce Examination

Ms Shruthy Myson, Registration Number: 1942075, PhD Scholar at the Department of Mathematics, School of Sciences, CHRIST (Deemed to be University) will defend her PhD thesis at the public viva-voce examination on Wednesday, 03 September 2025 at 11.30 am in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru – 560029, Karnataka, India.

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| **Title of the Thesis** | : | **Multilayer Heat Transport in Nanoliquids with Sensitivity Analysis** |
| **Discipline** | : | **Mathematics** |
| **External Examiner – I** | : | **Dr Ram Prakash Sharma**<br>Professor<br>Department of Mechanical Engineering<br>National Institute of Technology<br>Jote, Papum Pare District<br>Arunachal Pradesh - 791113 |
| **External Examiner – II** | : | **Dr B J Gireesha**<br>Professor<br>Department of Mathematics<br>Kuvempu University<br>Jnana Sahyadri<br>Shimoga - 577451<br>Karnataka |
| **Supervisor** | : | **Dr Mahanthesh B**<br>Associate Professor<br>Department of Mathematics<br>School of Sciences<br>CHRIST (Deemed to be University)<br>Bengaluru - 560029<br>Karnataka |

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

**Registrar (Academics)**

**Place:** Bengaluru
**Date:** 22 August 2025

# ABSTRACT

Multilayer flows commonly occur in industrial processes such as co-extrusion, film coating, and lubricated transport. These flows have important applications in the polymer and petroleum industries, oil extraction, and food processing. For example, in oil pipelines, multilayer transport can significantly reduce the pumping power required by introducing an appropriate amount of water to facilitate the movement of oil. In view of these significant applications, mathematical models are developed to analyze multilayer flow and heat transfer in fluids within a vertical slab, accounting for various physical effects such as nonlinear convection, interfacial coupling, and distinct thermophysical properties of each layer. Since industrial processes often operate at moderate to high temperatures, the analysis incorporates the nonlinear Oberbeck-Boussinesq approximation to more accurately capture thermal effects. Various other physical effects including the magnetic field, viscous dissipation, and thermal radiation were investigated. As far as the fluids are concerned, we have used incompressible non-Newtonian fluids and mono/hybrid nanofluids as the testing fluids. For realistic modelling, experimental data based nanofluid models were used.

The governing equations are constructed using the conservation laws of mass, momentum, energy and the constitutive equations are utilized for non-Newtonian fluids. The resulting dimensionless nonlinear differential multi-point boundary value problems were solved through analytical and numerical approaches. The entropy generation analysis is also performed. Since energy losses due to irreversibility inherently occur in any mechanically active device, analyzing this phenomenon becomes essential for loss mitigation and system optimization. The optimization of heat transport at the walls of a vertical slab is carried out using Response Surface Methodology (RSM), a mathematical-statistical approach based on the Design of Experiments (DoE). Quadratic empirical models are developed to perform sensitivity analysis. The results are presented both graphically and in tables, followed by a physical interpretation. The findings of this research may be useful for various engineering applications involving multilayer fluid transport.

**Keywords:** *Multilayer Flow, Micropolar Fluid, Bi-viscous Bingham Fluid, Third-grade Fluid, Response Surface Methodology, Sensitivity Analysis, Multi-point Boundary Value Problem.*

**Publications:**

1. **Shruthy Myson**, "Optimization procedure for multilayer heat transfer in nanoliquid with Joule heating using Response Surface Methodology", Methods of Mathematical Modeling, ed. Hemen Dutta, Academic Press, Elsevier, 2025.
2. **Shruthy Myson**, B. Mahanthesh and K. Vajravelu, "Study of multilayer flow of non-Newtonian fluid sandwiched between nanofluids", Partial Differential Equations in Applied Mathematics, vol. 13, p. 101053, 2025.
3. **Shruthy Myson** and B. Mahanthesh, "Sensitivity analysis of nonlinear convective heat transport of a hybrid nanoliquid sandwiched by micropolar liquid using RSM", Waves in Random and Complex Media, pp. 1-29, 2023.
4. B. Mahanthesh, **Shruthy Myson** and K. Vajravelu, "Study of multilayer flow of a bi-viscous Bingham fluid sandwiched between hybrid nanofluid in a vertical slab with nonlinear Boussinesq approximation", Physics of Fluids, vol. 34, no. 12, p. 122006, 2022.