INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	Abhijeet Rana
Roll Number	:	206122010
Programme of Study	:	Ph.D.

Thesis Title: Development of Water-Stable Metal-Organic Frameworks for Oil-Water Separation and Toxic Chemical Sensing

Name of Thesis Supervisor(s)	:	Prof. Shyam P. Biswas
Thesis Submitted to the Department/ Center	:	Chemistry
Date of completion of Thesis Viva-Voce Exam	:	07/07/2025
Key words for description of Thesis Work	:	Metal-Organic Frameworks, Chemical Sensing, Oil-Water Separation, Superhydrophobisity, Water Purification.

SHORT ABSTRACT

This thesis explores the development and application of functional metal-organic frameworks (MOFs) for environmental and sensing applications across five chapters. **Chapter 1** presents a comprehensive overview of the evolution, synthesis strategies, and tunable properties of MOFs, emphasizing their utility in catalysis, gas storage, sensing, and environmental remediation. **Chapter 2** details the synthesis of a hydrophobic Hf-based MOF (DUT-52 type) and its integration with polypropylene fabric, yielding a superhydrophobic, self-cleaning composite capable of efficiently separating oil from water under diverse conditions. **Chapter 3** introduces an eco-friendly, fluorine-free Zr-UiO-66-based MOF composite and membrane, demonstrating excellent recyclability, high oil absorption capacity, and robust performance in oil-water separation, making them sustainable alternatives for environmental clean-up. **Chapter 4** focuses on a luminescent Hf-MOF functionalized with thioureido groups for selective and sensitive dual-analyte detection of Hg^{2+} and hydrazine in aqueous media, offering fast response times and ultralow detection limits. **Chapter 5** presents the design of a hydroxy-naphthalene-based luminescent MOF for nanomolar-level detection of the tuberculosis drug rifampicin and the neonicotinoid pesticide nitenpyram in real-world samples, including body fluids, food, soil, and environmental water. Overall, this thesis highlights the versatility of MOFs as advanced materials for targeted environmental remediation and chemical sensing.