## Joint PhD Programme of IIT Guwahati and IIT (BHU) Varanasi – July 2024

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| **Sl. No.** | 01 |
| **Dept.** | Chemical Engineering |
| **Project Code** | JD_CL_PT-RU |
| **Joint Supervisors** | Dr.. Pankaj Tiwari, Department of Chemical Engineering, IITG; Dr. Rajesh Upadhyay, Department of Chemical Engineering & Technology, IIT (BHU) |
| **Title of the Project** | Investigation of Solid Flow in an Elevated Temperature Fluidized Bed with Decomposing and Non-Decomposing Liquid Injection through Side Wall Pneumatic Nozzles |
| **Project Summary** | Several industrial scale processes require fluidized bed to be operated at elevated temperature for various applications. Nitrate bearing waste stream is produced during processing of various nuclear materials. Thermal denitration process for decomposition of various nitrate streams (like ammonium nitrate, magnesium nitrate) in a gas-solid bubbling fluidized bed can be used (Bhowmick et al., 2012). High temperature fluidized beds with side wall injections are used to treat the nitrate bearing stream produced during processing of various nuclear materials which needs to be treated before disposal to the environment. The nitrate solution was introduced into the gas fluidized bed using external mix type twin fluid nozzle. The excess gas which was injected to assist atomization process increases the bed voidage. This may lead to severe gas bypassing and poor gas-solid contacting. This gas bypassing problem is more severe in a gas fluidized bed having multiple nozzle feeding. Also, the atomizing air has a very high velocity at the nozzle outlet, so it emerges as a jet with enough kinetic energy to even pierce the bed. The hydrodynamics and particle mixing pattern of the system significantly changes due to this jet-bed interaction. |
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| **Sl. No.** | 02 |
| **Dept.** | Civil Engineering |
| **Project Code** | JD_CE_AD-VA |
| **Joint Supervisors** | Dr. Arindam Dey, Department of Civil Engineering, IITG; Dr. Vishwajit Anand., Department of Civil Engineering, IIT (BHU) |
| **Title of the Project** | Seismic behaviour of buildings with varying superstructural and substructural systems considering soil-structure interaction effects |
| **Project Summary** | There are numerous existing and evolving techniques to ensure seismic safety of buildings. These can be broadly classified as superstructural and substructural systems. Superstructural systems include application of suitable lateral load resisting elements such as shear walls and braced frames or the effective use of adequately tuned mass dampers. The basic principles involve imparting global ductility to the building structure and to attenuate the structural vibrations during a seismic event. On the other hand, substructural systems towards seismic safety include the choice of a suitable foundation system amalgamated with seismic base isolation. Recent developments in this domain include adaptive seismic base isolation systems and use of seismic metamaterials. The basic idea is to isolate the existing superstructure from seismic waves in frequency band close to natural frequency of the structure. Hence, in a nutshell, the seismic response of building is affected by the characteristics of superstructure, substructure, soil and the soil-structure interaction phenomenon. Through this project, it is intended to study the seismic behaviour of buildings with variations in superstructural and substructural systems while considering the soil-structure interaction. The observations and inferences would be used to develop guidelines for selection of appropriate superstructural and/or substructural measures for seismic safety of buildings for different site conditions.<br>The project would incorporate the study of both RC frame and RC wall-frame buildings of different configurations. The influence of SSI on inelastic behaviour of the structures would be assessed in terms of the ductility capacity and ductility demands. The influence of incorporating SSI on the modification of the yield and ultimate drifts would be investigated to assess the modification in the ductility capacity of the RC frame and RC wall-frame systems. Lastly, the improvement in the global ductility of the RC frame and RC wall-frame systems would be ascertained by the application and usage of superstructural and substructural systems attempting to enhance seismic safety of the considered building configurations. |

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| **Sl. No.** | 03 |
| **Dept.** | Chemical Engineering |
| **Project Code** | JD_CL_RG-ST |
| **Joint Supervisors** | Dr. Raghvendra Gupta, Department of Chemical Engineering, IITG; Dr. Sweta, Department of Chemical Engineering & Technology, IIT (BHU) |
| **Title of the Project** | Computational Modelling of Gas-Solid Flow in High Temperature Fluidised Bed Reactors |
| **Project Summary** | Fluidised Bed Reactors are used in a number of industries, for example in the fluidised catalytic cracking unit (FCCU) in the petroleum industry, coal gasification, waste water treatment and nuclear power industry. The efficient design of the fluidised bed reactor requires understanding of the complex transport processes involved in the design of the reactor. In this project, we plan to develop two-dimensional and three-dimensional models of multiphase flow and heat transfer in the fluidised bed reactor using computational fluid dynamics (CFD) and discrete element method (DEM). Further, the application of machine learning techniques in accelerating the prediction will also be explored. |
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| **Sl. No.** | 04 |
| **Dept.** | Electronics and Electrical Engineering |
| **Project Code** | JD_EE_SN-JP |
| **Joint Supervisors** | Dr. Sisir Kumar Nayak, Department of Electronics and Electrical Engineering, IITG; Dr. Jeewan Chandra Pandey, Department of Electrical Engineering, IIT (BHU) |
| **Title of the Project** | Partial discharge analysis of an alternate liquid dielectric for power transformer |
| **Project Summary** | The ester oils (EOs) and blended oils (BOs) prove to be a good alternative to mineral oil (MO) due to their excellent biodegradability, fire and flash points. BOs provide a middle ground by balancing the cost and properties. Moreover, an involuntary blending of MO and EO occurs when an old MO based transformer is retrofilled with EO. MO and a commercial EO (FR3) are mixed in various ratios to prepare BOs in this work. The electrical and physiochemical properties such as MC, AC breakdown voltage, dissipation factor, relative permittivity, specific resistance, flash points, interfacial tension, and density of the BOs will be studied. The long-term performance of the BOs will also be studied by oxidative aging them according to ASTM D1934. Since oils undergo electric stress in the transformer during their operation, partial discharge (PD) study of the EO, MO, and BOs helps in understanding their behavior under electric stress and gives an insight into their relative performance under electric stress. The PD in the fresh and aged oils will be studied according to the IEC 60270 standard. |
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| **Sl. No.** | 05 |
| **School** | Mechanical Engineering |
| **Project Code** | JD_ME_AN-AS |
| **Joint Supervisors** | Dr. Arup Kumar Nandy, Department of Mechanical Engineering, IITG; Dr. Anubhav Sinha, Department of Mechanical Engineering, IIT (BHU) |
| **Title of the Project** | Modelling Flame-Obstacle Interactions for Hydrogen Safety |
| **Project Summary** | Hydrogen is rapidly emerging as a “green” replacement for the fossil fuels used today and is expected to be the dominant fuel source in near future. It offers zero carbon emissions and can also be harnessed to solve the water shortage. With the increasing demand for hydrogen, a rapid increase in hydrogen infrastructure is expected in the coming years. Large volumes of hydrogen will be stored, transported, and used. Hence, it becomes important to critically assess |

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| | safety aspects related to hydrogen. Hydrogen is highly diffusive and is more prone to leakage than other gaseous fuels. Further, hydrogen has much higher flame speeds and wider flammability limits than typical hydrocarbons. These properties make it more dangerous in case of an accidental explosion. EU, USA, and other major countries have safety standards [1-5] considering accidental Hydrogen explosion. A critical issue which is generally neglected in accidental explosion studies is the role of flame-obstacle interaction. Our model [6-10] has been accepted for EN-14994, which is a statutory standard for explosion safety in European Union. This model also proposed to MNRE and is under consideration for Indian standards. We wish to also propose an improved version of our model for Indian standards. This project aims to significantly enhance the model predictive capabilities, especially for realistic accidental scenarios like the presence of obstacles, using computational and analytical tools. The project is aiming to develop a model based on fluid-structure interaction. Vibration of the obstacle has a significant role in this model. |
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| **Sl. No.** | 06 |
| **School** | Chemical Engineering |
| **Project Code** | JD_CL_DB-AG |
| **Joint Supervisors** | Dr. Dipankar Bandyopadhyay, Department of Chemical Engineering, IITG; Dr. Abir Ghosh, Department of Chemical Engineering & Technology, IIT (BHU) |
| **Title of the Project** | Design and Fabrication of Liquid Crystal-based Lab-on-a-Chip Devices (LC-LoCDs): On-demand Coagulation Disorder Detection to Smart Drug Carrier Systems |
| **Project Summary** | The COVID-19 pandemic has brought to the forefront the necessity of Lab-on-a-Chip Devices (LoCDs) based Point-of-Care testing (PoCT). In this project, we propose introducing a novel multi-stimuli-sensitive material, i.e., nematic liquid crystals (NLCs), as a major integrant. We intend to design and fabricate such NLC-based LoCDs (LC-LoCDs) for the early detection of human blood coagulation disorders and implement the same as smart drug carrier systems. We aim to provide a theoretical and experimental construct wherein the co-annular flow of stimuli-enabled bio-compatible NLCs with platelets embedded in a carrier fluid matrix will be deployed to develop the proposed LC-LoCDs. |