INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : **Ph.D.**

Thesis Title: **NUMERICAL STUDY ON DROPLET BREAKUP DYNAMICS IN MICROCHANNELS**

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SHORT ABSTRACT

Droplets can be used as mini-reactors. They provide precise control over any reagent amount, which improves reaction repeatability and uniformity. The small droplets decrease exposure to potentially hazardous chemicals. The food industry, diagnostic testing, cosmetics, supra-magnetic nanoparticle production, medication delivery, and drug discovery all use homogeneous droplets. Droplets are often formed by mechanical agitation. However, mechanical mixing produces droplets of varying sizes. This might jeopardize process controllability. Microfluidics, the study of fluid dynamics at the micro to the nanoscale, enables the control of droplet size and quantity. With hundreds to thousands of droplets formed each second, the throughput of droplet formation rises. Droplets can be formed using i) Active method ii) Passive method. The passive method includes various ways, such as T-junction, co-flow, flow-focusing, and some variants. On the other hand, additional energy such as alternating or direct current is applied in the case of active splitting. In this work, an interest was felt in doing the numerical study on droplet breakup dynamics in microchannels using the passive method with the help of CFD. The objectives of the present work are as follows:

I. A computational study on phase velocity mediated droplet splitting and its mechanism at T-junction microchannel

II. Influence of microchannel geometry on droplet breakup dynamics: a computational study

III. Numerical appraisal on liquid-liquid two-phase flow in a flow-focusing system

IIIa. 2D simulation of dripping and jetting flow in a flow-focusing geometry

IIIb. 3D simulation of dripping and jetting phenomena in a flow-focusing geometry

IV. Two-dimensional numerical simulation of droplet splitting in multi-furcating microchannel