Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Abhijit Deshpande**
URL	https://www.che.iitm.ac.in/~abhijit
Ph.D. Topics	**1) Thin gap rheology - microscopic heterogeneity and their influence on rheological measurements:** When chew food items, the mouth-feel depends on the thinnest layer of food being sheared in our mouths. The thinnest layer of food is heterogeneous, while most of rheology assumes homogenous material. How do we examine rheology, when materials inherently are heterogeneous. Can we propose novel methods to characterize rheology of heterogeneous materials measured in gap-dependent protocols? The project will involve experimental characterization using rheometers. To complement the understanding, constitutive modeling (using Matlab) may also be involved.

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M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Aravind Kumar Chandiran**
URL	http://aravindiitm.wixsite.com/solarenergy
Ph.D. Topics	**1) Biophotovoltaic devices for solar energy conversion:** PI: Aravind Kumar Chandiran, CoPI: Raghunathan Rengaswamy Nature uses photosynthetic organisms to effectively convert sunlight to chemical products via the process of photosynthesis. Unlike artificial solar energy conversion, the former systems have a capability to self-repair on damage and perform their business-as-usual. In this project, students will utilize such 'self-repairing' living microbial systems in solar cells, perform photovoltaic studies, understand the device physics and model the system. No prior experience on the topic is needed, however, preferred.
M.S. Topics	**1) Large area perovskite solar cells** Thin film solar cells based on perovskites have significant attention during the last 8 years because of very high power conversion efficiency and ease of fabrication. This offers significant potential for the future of low cost photovoltaic devices. In this proposed project, student will work on developing large area solar cells using the expertise in the research group. This project is a part of our ISRO collaborative work. No prior solar cell experience is needed. However, a good academic track record and motivation to carry out challenging tasks are essential
	2) Solar rechargeable battery The cost of solar energy conversion still remain expensive because of the multicomponent system involved in the process. Typically solar cells converts the sunlight to electricity and storage of electricity, at the moment, is dominated by batteries. This dual-system of conversion and storage increases the cost of solar electricity. In this project, student will work on developing new materials to create a single electrochemical device wherein both the energy conversion and storage will happen. Students with interest to develop semiconductor materials and fabricate devices shall apply for this project. No prior experience on the topic is needed.
	3) Design and validation of photoelectrochemical reactors for solar hydrogen generation (co-advisor: Niket Kaisare): This project targets combining experiments and modeling for design and analyses for photoelectrochemical (PEC) reactors for water splitting using sunlight for hydrogen generation. Multiscale modeling approach will be used, considering all the device parameters, including the absorption coefficient of semiconductor, mass transport of ionic species (OH- or H+), diffusion coefficient of electronic charge carriers and the catalytic property of water oxidation and reduction. The optimal PEC reactor will be fabricated to validate the theoretically observed parameters

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Arun K Tangirala**
URL	http://www.che.iitm.ac.in/~arunkt/
Ph.D. Topics	**1) Identification of multiscale systems** Data-driven modelling of multiscale systems is a challenging problem mainly due to the spread of dynamics across several time-scales. The objective of this work is to develop methods for identifying multiscale systems, especially in the state-space framework
	2) Adaptive data-driven non-destructive evaluation and structural health monitoring (in collaboration with Michigan State University, dual Ph.D. program) The project is in collaboration with faculty from Michigan State University, Lansing. It is concerned with using sparse optimization and multivariate data analysis techniques to solve problems in designing sensor networks and analyzing the resulting data. The candidate will be required to spend at least two years at MSU.
	3) Data-driven dynamical causal network modelling of processes This project is a fairly generic one that involves developing dynamical causal network models from data that can be used for fault detection, control loop performance monitoring,
	4) Inverse (estimation / soft sensing) problems This is a joint project with Michigan State University, Lansing towards a dual Ph.D. One of the problems of interest in sight is soft sensing of heat release rate in thermoacoustic combustion systemsusing pressure and other available measurements.
M.S. Topics	**1) Identification of state-space models from noisy measurements using multivariable data analysis techniques** This project is concerned with developing method for identifying state-space models using ideas from dynamical iterative principal component analysis (in collaboration with Prof. Shankar Narasimhan)
	2) Dynamical modelling of water networks from data The problem is concerned with developing dynamical models of water networks from measurements. This project will be carried out in collaboration with Prof. Shankar Narasimhan.
	3) Any problem of interest (to the candidate) in data sciences with applications to engineering / biological processes.

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Jithin John Varghese**
Email	varghesejithinjohn@gmail.com
Ph.D. Topics	**1) Oxidative dehydrogenation of natural gas derived alkanes to alkenes** With increasing demand for olefins like ethylene and propylene, the dehydrogenation of their corresponding alkanes is emerging as a promising process. Oxidative dehydrogenation (ODH) of ethane and propane which are components of natural gas, to ethylene and propylene is an attractive route for their upgradation. However, the commercial development of this technology is still struggling with the lack of selective and high yielding catalysts. Doped nickel oxide (NiO) materials and hexagonal boron nitride (HBN) have been shown to be active and selective in ODH reactions involving ethane and propane. In this project, using molecular modelling tools, the effect of different dopants/promoters in NiO based catalysts will be systematically studied to understand their effects on various aspects of the catalytic process involving both these feedstocks. Reaction mechanisms and pathways, with energetics for the ODH of ethane and propane on the HBN will be investigated and the effect of defects and dopants in HBN will be analysed. Note: Computational work. Prior experience with molecular modelling is not required.
	2) Liquid phase mild oxidation of methane to methanol and acetic acid on atomically dispersed metal catalysts Atomically dispersed transition metal atom catalysts within the zeolite frameworks and metal oxides are promising for the mild oxidation of methane in liquid phase reactions directly to methanol and to acetic acid in the presence of CO. This project will use molecular modelling to investigate the reaction pathways and energetics for the formation of methanol directly from methane and acetic acid in the presence of CO on atomically dispersed transition metals on metal oxides. A screening of transition metals and metal oxide combinations would be done to identify potential catalytic materials and key descriptors which can be used to tune selectivity to desired products. The role of aqueous environment in the reaction mechanism/energetics if any and the mechanism of oxidation using H2O2 will be investigated. Note: Computational work. Prior experience with molecular modelling is desirable but not compulsory.
M.S. Topics	**1) Mechanistic insights into oxidative upgradation of methane on ceria-based catalysts** Utilization of abundantly available methane as a chemical feedstock enables to develop alternate chemical routes to produce currently petroleum-derived chemicals. Catalysts and processes for the direct oxidative conversion of methane into oxygenates like methanol and C2 hydrocarbons like ethylene, both of which are commodity chemicals are highly desirable. Ceria based catalysts have shown promise in oxidative upgradation of methane. This project will focus on deriving mechanistic insights into the C-H bond activation of methane, C-C and C-O bond formation on metal oxide dispersed ceria-zirconia catalysts using first principles calculations. The pathways and energetics for the formation of oxygenates like methanol and ethanol, as well as C2 hydrocarbons like ethane and ethylene will be identified to help tune reaction conditions for the desired product. Note: Computational work. Prior experience with molecular modelling is not required

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Kannan A**
URL	http://www.che.iitm.ac.in/~kannan/
Ph.D. Topics	**1) Process Intensification of Adsorption Processes handling Emerging Contaminants** Design of Experiments, Simulation, Optimization and Experimental Validation
	2) Design of Experiments, Simulation, Optimization and Experimental Validation Multifunctional High Capacity Adsorbents
M.S. Topics	**1) Understanding Adsorption Mechanisms** Understand competitive behavior for active adsorbent sites during simultaneous adsorption of toxic compounds

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Madivala G Basavaraj**
URL	https://scholar.google.co.in/citations?user=iJI-8rkAAAAJ&hl=en
Ph.D. Topics	**1) Emulsions and blends as alternate fuels** The objective of this work is to investigate the fundamental physical chemistry of emulsions and blends for use as alternate fuels in internal combustion engines. The work will involve formulation of emulsions, investigation of stability and engine studies. The proposed work will be carried out in collaboration with Prof. Niket Kaisare, Department of Chemical Engineering, IIT Madras
	2) Controlled Manipulation of Cracks in Drying Films: Drying films often display a network cracks and are ubiquitous. Cracks can be found when looking at the dried pond surface, on the surface of the old oil paintings, concrete slabs, painted walls etc. Why do these films crack? What is role of differential shrinkage of the film during drying on cracks? Can these cracks be controlled, altered or completely supressed? Can these cracks in particulate film be useful for some sort of applications ? How number of cracks scales with thickness of the layer? Are these cracks correlated with the microstructure of the layer? and so on… This project proposes to provide answers to some of these questions and to develop a novel strategy for controlled manipulation cracks formed in films. One robust approach to control the cracks is to modulate the drying induced stresses in particulate layers using external agents like, electric field, magnetic field, thermal field, structuring of the substrate etc. Another approach is to exploit the shape anisotropy of the particles that constitute the layer. This project involves fabrication particulate films using various thin film deposition techniques including self assembly routes. Next, the understanding of the formation of network of cracks and their controlled manipulation by smart choice of external agents will be explored in detail by performing systematic experiments. The proposed work will be carried out in collaboration with Prof. Dillip K Satapathy, Department of Physics, IIT Madras
	3) Interfacial rheology of particle monolayers Colloidal particles deposited at fluid-fluid interfaces form particle monolayers, which are model systems to investigate colloids in two dimensions. The objective of this work is to investigate the mechanical response of particle monolayers to compression and shear. The work will involve the use of Langmuir troughs and interfacial rheological measurements.
M.S. Topics	**1) Large scale production of non-spherical polymeric particles** Stretching of polymer films containing colloidal particles is shown to be a convenient and effective method to transform the shape of particles. The objective of this project is to develop an automated stretching device for controlled fabrication of polymeric particles of various sizes and shapes.
	2) Design and validation of photoelectrochemical reactors for solar hydrogen generation (jointly with Prof. Aravind Kumar Chandiran) This project targets combining experiments and modeling for design and analyses for photoelectrochemical (PEC) reactors for water splitting using sunlight for hydrogen generation. Multiscale modeling approach will be used, considering all the device parameters, including the absorption coefficient of semiconductor, mass transport of ionic species (OH- or H+), diffusion coefficient of electronic charge carriers and the catalytic property of water oxidation and reduction. The optimal PEC reactor will be fabricated to validate the theoretically observed parameters.

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Niket Kaisare**
URL	http://www.che.iitm.ac.in/~nkaisare/
Ph.D. Topics	**1) Enhancing Human Machine Interface for Advanced Control Applications (jointly with Prof. Raj Srinivasan)** Advanced Control technologies such as Model Predictive Control (MPC) are very popular in the chemical, oil and gas, and allied process industries. These technologies are complex but offer many advantages including (1) the ability to seek optimality (cf. energy efficiency, profit maximization, etc), (2) incorporate constraints, and (3) handle the inherent multivariate nature of the control problem. Human operators oversee the operation of advanced control applications and turn them off if their behaviour is not intuitive to them. Our goal in this project is to enable advanced control technologies to be used continuously, despite the many changes that are inevitable during the lifetime of a plant. Specifically, we will develop new Human Machine Interfaces (HMIs) that will allow process control personnel to easily understand the actions of MPC.
	2) Emulsions and blends as alternate fuels (jointly with Prof. M.G. Basavaraj) The objective of this work is to investigate the fundamental physical chemistry of emulsions and blends for use as alternate fuels in internal combustion engines. The work will involve formulation of emulsions, investigation of stability and engine studies
M.S. Topics	**1) Modeling of Lean NOx Traps (jointly with Prof. Preeti Aghalayam)** Lean NOx Traps, based on sequential storage and reduction reactions of NOx on a unique set of catalytic materials, is an important aftertreatment strategy for lean burn automotive engines. We have recently developed a handy kinetic model for LNT. Incorporating the kinetic model into an improved reactor model in order to establish the efficacy of LNT for practical applications will be undertaken here. (Computer Simulations)
	2) Design and validation of photoelectrochemical reactors for solar hydrogen generation (jointly with Prof. Aravind Kumar Chandiran) This project targets combining experiments and modeling for design and analyses for photoelectrochemical (PEC) reactors for water splitting using sunlight for hydrogen generation. Multiscale modeling approach will be used, considering all the device parameters, including the absorption coefficient of semiconductor, mass transport of ionic species (OH- or H+), diffusion coefficient of electronic charge carriers and the catalytic property of water oxidation and reduction. The optimal PEC reactor will be fabricated to validate the theoretically observed parameters.
	3) Multi-Objective Optimization and Scheduling of Catalytic Cracking and Hydro-Cracking (Co-Guide: Dr. Ulaganathan, ABB Corporate Research) This project will involve development of detailed simulation models, model reduction and using the model in real-time optimization and scheduling problems in catalytic cracking / hydrocracking operations.

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Preeti Aghalayam**
URL	https://che.iitm.ac.in/?page_id=357
Ph.D. Topics	**1) Catalyst development and application in lean burn automotive emissions control** In this work, catalytic materials for reduction of NOx in lean burn engine conditions will be synthesised and characterised. Reactor experiments to demonstrate the viability of the prepared materials in NOx reduction will be conducted. Detailed kinetic modeling work, improving upon existing work in the group will be undertaken, & simulation results validated against experiments.
M.S. Topics	**1) Modeling of Underground Coal Gasification** Underground Coal Gasification has good potential for future coal utilisation in India. The UCG cavity is a unique chemical reactor with several interesting phenomena occurring simultaneously. In this project, predictive models for UCG performance, focussing on the cavity will be developed. The models will be used to further fit into a model of the economics of UCG product gas, for India. (Mathematical modeling, Code development, Simulations, Economics modeling).
	2) Modeling of Lean NOx Traps (co-guided by Niket Kaisare) Lean NOx Traps, based on sequential storage and reduction reactions of NOx on a unique set of catalytic materials, is an important aftertreatment strategy for lean burn automotive engines. We have recently developed a handy kinetic model for LNT. Incorporating the kinetic model into an improved reactor model in order to establish the efficacy of LNT for practical applications will be undertaken here. (Computer Simulations)
	3) Catalyst development and application in lean burn automotive emissions control In this work, catalytic materials for reduction of NOx in lean burn engine conditions will be synthesised and characterised. Reactor experiments to demonstrate the viability of the prepared materials in NOx reduction will be conducted. Detailed kinetic modeling work, improving upon existing work in the group will be undertaken, & simulation results validated against experiments. (Lab Experiments, Mathematical Modeling, Computer Simulations)
	4) Kinetic modeling of soot formation in turbulent flames The problem of fine particular matter (soot) from aircraft engines is to be studied using various laboratory scale studies. In collaboration with colleagues in Aerospace engineering, in this work, a model based on detailed kinetics for soot formation is to be developed. Work on laminar flames has recently been completed in the group, and the new project will extend the same to turbulent flame conditions using commercial software. (Computer Simulations)
	5) NOx reduction strategies for two-wheeled automobiles The number of two-wheelers on Indian roads is high and likely to increase further. Current strategies for reduction of tailpipe emissions in automobiles involve the use of catalytic converters, which have a limited range of efficient operation. New strategies to meet the increasing demands of improved regulations are to be explored in this project, using kinetic modeling and reactor simulations (Mathematical modeling, Computer simulations)

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. S. Pushpavanam**
URL	https://www.che.iitm.ac.in/~spush
Ph.D. Topics	**1) Modeling of the dry slag granulation process using rotating disc/cup** This is an industrial sponsored project focusing on developing an innovative technology to recovery heat from blast furnace slag from steel industry. The project involves simulations of flow on a rotating disc and studying the heat transfer characteristics. The work will be primarily computational and involve some experiments.
M.S. Topics	**1) Lattice Boltzman simulations of multiphase flows in microchannels** Multiphase flows in microchannels exhibit different flow regimes. Lattice Boltzmann methods are a computionally efficient tool to simulate these flows under controlled conditions. An advantage here is the interface is modeled as a diffuse region and not a sharp boundary.

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Raghuram Chetty**
URL	http://www.che.iitm.ac.in/~raghuc/
Ph.D. Topics	**1) Nanomaterials for Proton Exchange Membrane Fuel Cells.** Fuel cells have attracted considerable interest in recent years as a clean energy conversion technology. This project involves developing nanomaterials to improve the fuel cell efficiency.
M.S. Topics	**1) Development of integrated renewable energy sources for powering a remote house (co-guide: Aravind Kumar Chandiran):** This project invlolves developing an hybrid renewable energy based intergerated power system for a remote installation at hills.
	2) Electrochemical Oxidation of Lignin (co-guide: R. Vinu) Lignin is a major by-product of pulp and paper industry. Electrochemical oxidation treatment is an environmentally friendly method for effective degradation of organics. In this project, optimization of electrochemical parameters and reactor design for generating industrial chemicals from lignin will be explored.

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Rajagopalan Srinivasan**
URL	https://www.che.iitm.ac.in/~raj/
Ph.D. Topics	**1) Enhancing Human Machine Interface for Advanced Control Applications (co-guide: Dr. Niket Kaisare)** Advanced Control technologies such as Model Predictive Control (MPC) are very popular in the chemical, oil and gas, and allied process industries. These technologies are complex but offer many advantages including (1) the ability to seek optimality (cf. energy efficiency, profit maximization, etc), (2) incorporate constraints, and (3) handle the inherent multivariate nature of the control problem. Human operators oversee the operation of advanced control applications and turn them off if their behaviour is not intuitive to them. Our goal in this project is to enable advanced control technologies to be used continuously, despite the many changes that are inevitable during the lifetime of a plant. Specifically, we will develop new Human Machine Interfaces (HMIs) that will allow process control personnel to easily understand the actions of MPC.
	2) Cognitive Engineering for Process Safety Modern chemical plants have numerous layers of protection to ensure safety, however the task of human operator is the most critical. When plant operators lose control, undesirable consequences including property damage, injury, and sometimes loss of lives follow. It is therefore important to continuously monitor the plant operators' situation awareness to ensure that they take the right decisions to ensure safe and optimal operation. In this study, we will experimentally study the cognition of control room operators and develop AI and deep learning based models to prevent human error.
	3) Hierarchical Process Monitoring Modern chemical processes are large and complex; therefore traditional, monolithic strategies are not always well suited for detecting and identifying faults. In this project, we will develop a framework for distributed fault detection and identification (FDI), wherein the process is decomposed hierarchically into sections and subsections based on a process flow diagram. Multiple hierarchical FDI methods at varying levels of granularity will be deployed to monitor the various sections and subsections. The results from the individual FDI methods containing mutually non-exclusive fault classes will be fused together using Bayesian and other evidence aggregation techniques.

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Name of Faculty	**Dr. Rajnish Kumar**
URL	https://che.iitm.ac.in/?page_id=386
Ph.D. Topics	**1) Solidified Natural Gas for storage and transportation of natural gas** It is an experimental project involving gas hydrate formation, thermodynamics, crystallization kinetics and scale up.
M.S. Topics	**1) Desalination via gas hydrate formation and dissociation cycle** Project involves study of formation and dissociation kinetics of gas hydrate.

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Name of Faculty	**Dr. R. Ravi Krishna**
URL	http://www.che.iitm.ac.in/~rrk/Home.html
Ph.D. Topics	**1) Assessment of Enhanced NAPL transport in Porous media using MRI** The project is a continuation of ongoing work on the enhanced non aqueous phase liquids (NAPLs) such as oils in water saturated porous media. Under conditions of drying, these NAPLs have been observed to rise. This magnitude of the rise is greater than that observed with capillary action. We would like to inspect this further using a non invasive tool such as MRI. We would also like to model this behavior.
	2) Fate and transport of pharmaceuticals and antibiotics in the environment which lead to antibiotic resistant microbes This project looks at the increasing report of antimicrobial resistance (AMR), which is the resistance of microbes to anti biotics. The theory is that microbes are resistant to antibiotics since they have acclimatised. The hypothesis is that somewhere in the environment, the microbes get an opportunity to acclimatise. We would like to investigate this in detail. This project will involve collecting large amounts of microbial and chemical data of water and air and then test our hypothesis through a combination of In this project we will try to track the fate and transport of the factors and co-factors causing the AMR through field, lab experiments and some modeling.
M.S. Topics	**1) Computational Fluid Dynamics of Aerosol Dynamics in Dense Urban Traffic Environments (Co guided with Prof. Sreenivas Jayanti)** In this project, the objective is to track particulate matter in dense traffic environments in an attempt to track the exposure of receptors at road level (1-2 m height) to air pollution from the vehicles and the road. The factors influencing this are the presence of other vehicles and the movement of these vehicles that renders the entire regime very complicated. This study will done through a CFD simulation of the traffic and the exhaust flows. Three students have already worked on the preliminaries of this project. This can be converted to a PhD topic if sufficient progress is made in the first 1.5 years. There is scope to measure or model specific parameters
	2) Measurement and modeling of emission factors of dust from various activities in urban and rural environments Emission factors (amount of pollutant released per unit activity) for air pollution are very important for application in dispersion models. We would like to develop methods to either predict and/or measure these emission factors for a large number of scenario in urban and rural environments. This is part of a large project that is underway for the estimation of the effect of aerosols on climate and health.

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M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. T. Renganathan**
URL	http://www.che.iitm.ac.in/~renga/
Ph.D. Topics	**1) 3-phase countercurrent gas-liquid-solid adsorber** Continuous stream of liquid and solid are contacted in a countercurrent liquid solid system (CCLSS). This system can be used for steady state removal of colour from dye industry effluent compared to a transient removal in a packed bed. Gas is also sparged along with liquid in the three phase system. The present work involves studying the influence of gas on the fluid dynamics and mass transfer in CCLSS.
	2) Flow pattern in countercurrent ozonation column Ozonation of water can be carried out in a countercurrent bubble column (CCBC) in which ozone and water to be treated flow countercurrently. The present work will involve studying the flow pattern and bubble characteristics in CCBC without and with solid particles.
	3) Microfluidics based sensor for detection of pollutants in water Microfluidics based sensors can be effectively used to detect water-borne pollutants like pharmaceuticals, heavy metals, drug resistant bacteria etc. The present work will involve practical development of such sensors and theoretical analysis of their performance. This work is part of a DST sponsored Indo-UK project to be carried out in India and UK. The student will be jointly guided with Prof. S. Pushpavanam
M.S. Topics	**1) 3-phase countercurrent gas-liquid-solid adsorber** Continuous stream of liquid and solid are contacted in a countercurrent liquid solid system (CCLSS). This system can be used for steady state removal of colour from dye industry effluent compared to a transient removal in a packed bed. Gas is also sparged along with liquid in the three phase system. The present work involves studying the influence of gas on the fluid dynamics and mass transfer in CCLSS.
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Name of Faculty	**Dr. Sridharakumar Narasimhan**
URL	https://che.iitm.ac.in/?page_id=404
Ph.D. Topics	**1) Online Data Analysis for Rapid Identification and Control of Reaction Systems using Spectroscopy** Jointly with Nirav Bhatt. Rapid process development using data generated in laboratory is important in chemical, pharma, specialty and biotech industries. Furthermore, growth in product demand has pushed these industries to adopt continuous process manufacture for new and existing processes. Further, in production, these processes have to be monitored and controlled to ensure safety and quality standards approved by regulatory agencies. A reliable kinetic and transport model is important for monitoring, control, and optimization of reaction systems during production and rapid process development. Spectrometers allow to monitor reaction systems in an in-line, on-line or at-line manner. The main objective is this work is to develop online data analysis tools for rapid identification and control of reaction systems based on spectral and temperature data. Some references related to the topic are as follows: 1. J. S. Moore, K. F. Jensen,"Batch Kinetics in Flow: Online IR Analysis and Continuous Control", 2014, Angew. Chem, 126, 480-483. 2. N. Bhatt, Extents of Reaction and Mass Transfer in the Analysis of Chemical Reaction Systems, PhD Thesis, EPFL, 2011 3. S. Mozharov, A. Nordon, D. Littlejohn, C. Wiles, P. Watts, P. Dallin, J M. Girkin, 2011, Improved Method for Kinetic Studies in Microreactors Using Flow Manipulation and Noninvasive Raman Spectrometry, J. Am. Chem. Soc., 133, 3601-3608.
	2) Operation of intermittent water networks Water distribution networks are important civic assets transporting water from sources to end consumers through a network of pipes, valves, pumps and tanks. Water networks in India and several other countries are operated intermittently rather than 24x7 due to several constraints. Operation of networks in such a manner has been implicated in poor water quality. This project will involve studying such systems and coming with models for predicting quality spatially and temporally and determining alternate operation strategies for maximizing quality.
	3) Leak detection in pipelines Fluid transients in pipes—water hammer waves—are changed by pipeline properties, including leaks and blockages, thus leaving clues to such properties. Analysis of transients can reveal a substantial amount of information concerning the integrity of the system. Numerous methods utilize transient behavior for the purpose of leak detection. While a pipeline reinforces and transmits input signals of a particular frequency (for example, the fundamental frequency), others are effectively absorbed within the system. The degree that each frequency component is absorbed or transmitted within the pipeline is defined by a frequency response diagram (FRD), also known as the transfer function for the system. This project will involve designing an appropriate input signal for perturbing pipelines and networks of pipelines in order to determine the leak location using dynamics.

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Name of Faculty	**Dr. Sreenivas Jayanti**
URL	https://che.iitm.ac.in/?page_id=401
Ph.D. Topics	**1)** Improved designs of vanadium redox flow battery stacks" Please contact Prof. Sreenivas Jayanti for more details
M.S. Topics	**1)** Improved designs of vanadium redox flow battery stacks" Please contact Prof. Sreenivas Jayanti for more details

Department of Chemical Engineering, IIT Madras
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Name of Faculty	**Dr. Susy Varughese**
URL	https://che.iitm.ac.in/?page_id=414
Ph.D. Topics	**1) Tailoring microstructure of conducting polymers for robust flexible electronics**
	2) Structure-property relations in natural polymers
	3) Sustainable recycling of polymers

Department of Chemical Engineering, IIT Madras
M.S. and Ph.D. Topics Offered by Faculty Members (June 2018)

Name of Faculty	**Dr. Upendra Natarajan**
URL	https://sites.google.com/site/upendranatarajan/
Ph.D. Topics	**1) Diffusion and thermodynamics of complex polymer solutions using molecular simulations**
	2) Development of new mathematical models for polymer-surfactant mixtures in solution using molecular theory
	3) Modeling of Solvation and aggregation/association of charged polymers in aqueous solution: structure, thermodynamics and transport
	4) Statistical analysis and properties of complex polymer and copolymer chains by numerical simulations
	5) Geometry and dynamics of complex polymer-surfactant aggregates in solution by molecular simulation
M.S. Topics	**1) Statistical modeling of polymer mechanical properties**
	2) Analysis of molecular properties of polymers