

A Global Initiative of Academic Networks (GIAN)

A one-week course on

Particle Engineering in the Pharmaceutical Industry: Colloidal Engineering and Crystallization

**Sponsored by Ministry of Human Resource Development (MHRD), Govt. of India
Under the Scheme 'GIAN'**

**(5th March 2018 to 9th March 2018) @ Department of Technology,
University College of Technology, Osmania University, Hyderabad, Telangana- 500 007**

Overview

The course aims at delivering in-depth knowledge on crystallization techniques, colloidal engineering, aggregation and fragmentation and population balance modeling. The study of colloids and interfaces is highly multidisciplinary in nature combining both the concepts and applications from such diverse domains as chemical engineering and manufacturing, analytical and physical chemistry, biochemistry and molecular biology, environmental science, materials science including biomaterials and advanced materials, petroleum engineering and finally, nanotechnology.

The proposed course focuses on practical applications of crystallization and colloidal systems in pharmaceutical industries. Colloids are a heterogeneous system in which particles of a few nanometers to hundreds micrometers in size are finely dispersed in liquid medium, but show homogeneous properties in macroscopic scale. In particular, recent advances in colloidal science have focused on nano-bio materials and devices which are essential for drug discovery and delivery, diagnostics and biomedical applications. It is known worldwide that Hyderabad is a hub of pharmaceutical industries, with more than 200 out of the 600 bulk drug-manufacturing units in India. This course opens the door to new research areas and also opportunity to strengthen our existing collaboration with the pharmaceutical industries.

The course educates and trains graduates with the academic and practical background necessary to function as chemical engineering professionals in several modern, state of the art industrial enterprises such as manufacturing of pharmaceutical drugs, nanotechnology and bio-medical engineering. The course provides our graduates with the foundation for a successful career and enables life-long learning on applications of population balance modeling.

Objectives

The primary objectives of the course are as follows:

- i) Understanding the concepts involved in particle and colloidal engineering.
- ii) To enable the participants to describe the evolution of a population of particles by population balance modeling.
- iii) Providing exposure to practical problems and their solutions, through case studies and live projects in understanding crystallization, aggregation and fragmentation.

Day 1 26 th February	1 h	Inauguration, Participants Introduction and Course description	VVB+MB + JT
	2 h	Current trends in pharmaceutical crystallization We will discuss novel and established crystallization processes and identify the driving force for crystallization in each case. Key words: cooling vs. anti-solvent crystallization, batch vs. continuous	MB + JT
	2 h	Importance of Novel Separation Processes	VVB
Day 2 27 th February	2 h	Factors affecting crystal particles I: Nucleation Review of classical nucleation theory and outline its shortcomings, in particular recent theories on the stochasticity of nucleation and how it helps us to interpret experimental data.	MB
	2 h	Factors affecting crystal particles II: Growth and agglomeration Review on theories for crystal growth and experimental procedures how it can be measured in experiment.	MB
	2 h	Factors affecting crystal particles III: Other aspects Polymorphism, crystal shape, co-crystals, spherical crystallization	MB + JT
Day 3 28 th February	2 h	Population balance modeling I: Size distribution and PBE A population balance equation (PBE) describes the evolution of the crystal size distribution in time and space. In this first lecture we will establish the properties of crystal size distribution and introduce the framework of PBE.	MB
	2 h	Population balance modeling II: PBE for specific reactors PBE with nucleation and growth for antisolvent and cooling crystallization in batch and continuous tubular systems.	MB
	2h	Tutorial	MB
Day 4 1 st March	2 h	Population balance modeling III: agglomeration and fragmentation in crystallization Introduce the formalism for describing agglomeration and fragmentation within the framework of PBE.	MB
	2 h	Population balance modeling IV: Agglomeration rate, analogy to aggregation in colloidal systems More details on how the agglomeration rate depends on the crystal properties, in particularly their size. Also, we will establish the analogy to the aggregation of colloidal particles and what we can learn from these systems.	MB
	2h	Tutorial	MB
Day 5 2 nd March	2 h	Population balance modeling V: Fragmentation rate, analogy to fragmentation in colloidal systems Discuss on factors that cause fragmentation and how models can be formulated. Also, about fragmentation in colloidal systems driven by hydrodynamic stress.	MB
	2h	Research Opportunities in the Particle Engineering, Question and Answers; Discussion; Student Feedback and Wrap up	MB, VVB, JT

Who Should Attend	Engineers and researchers from manufacturing service and government organizations including R&D laboratories. Student at all levels (BTech/MSc/M.Tech/PhD) or Faculty from academic institutions and technical institutions.
Fees	The participation fees for taking the course is as follows: Participants from Abroad : US \$500 Industry/ Research Organizations: Rs. 6,000 /- Faculty from Academic Institutions: Rs. 3,000 /- Student Participants: Rs. 1,000/- The above fee includes all instructional materials, tutorials, assignments and internet facility. On request, accommodation will be provided for few participants (on first come first basis) in the campus on payment.
How To Register	Stage1: Web (Portal) Registration: Visit GIAN Website at the link: http://www.gian.iitkgp.ac.in/GREGN/index and create login user ID and Password. Fill up blank registration form and do web registration by paying Rs. 500/- on line through Net Banking/ Debit/ Credit Card. This provides the user with life time registration to enroll in any no. of GIAN courses offered. Stage2: Course Registration (Through GIAN Portal): Log in to the GIAN portal with the user ID and Password created. Click on “Course Registration” option given at the top of the registration form. Select the Course title “ Particle Engineering in the Pharmaceutical Industry: Colloidal engineering and Crystallization ” from the list and click on “Save” option. Confirm your registration by Clicking on “Confirm Course”. Only Selected Candidates will be intimated through E-mail by the Course Coordinator. They have to remit the necessary course fee in the form of DD drawn in favor of “ PRINCIPAL UCT OU ” payable at SBI, University College of Technology, Osmania University, Hyderabad-500 007. OR through NEFT/RTGS: Name of the Beneficiary: Principal, College of Technology, OU Account Name: Principal, College of Technology, OU Name of The Bank: State Bank of India, Osmania University, Hyderabad Beneficiary A/C No: 52198262941 IFSC Code: SBIN0020071

Course Faculty (MB)



Dr. Matthaus Babler is an Associate Professor in Chemical Engineering at KTH Royal Institute of Technology, Stockholm, Sweden. His research in the field of particle technology focuses on colloidal fluid-particle systems, pharmaceutical crystallization, and gasification of biomass. His research includes both experimental approaches and numerical simulations, including population balance modelling and computational fluid mechanics.

Dr. Babler received his PhD in 2007 from ETH Zurich, Switzerland. His PhD thesis dealt with aggregation and fragmentation of polymeric colloids in turbulent flows. After his PhD he worked as a process engineering at Buhler AG in Switzerland before joining the Separation Process Laboratory at ETH as a post-doc. In his post-doc studies he worked on the separation of enantiomers by crystallization and chromatography. In 2010 he joined the faculty at the Dept. of Chemical Engineering at KTH where he continued his research in

pharmaceutical crystallization, colloidal engineering, and fluid-particle systems. In 2015 he got awarded the title of *Docent* from KTH.

Dr. Babler has published 25 papers in peer reviewed journals and is a regular speaker at international conferences. As part of his research he worked on two European projects related to pharmaceutical crystallization and he also joined two European COST actions devoted to particles in turbulence. In last 4 years he has supervised and co-supervised 4 PhD students and 21 Master thesis projects 21, among which 10 were in collaboration with industry.

Dr. Babler is an experienced teacher in chemical engineering. In the last years he taught courses on transport phenomena, separation process engineering, mathematical modelling, and numerical process simulation on the Bachelor and Master level.

Dr. VV Basava Rao: Course Coordinator



Dr. V. Venkata Basava Rao obtained M.Tech (1988) and Ph D (1991) in Chemical Engineering from IIT-Kharagpur & B.Tech (1986) in Chemical Engineering from Andhra University, Visakhapatnam. He worked in M/S. Bharat Dynamics Limited, Bhanur (1991-1995) for 4 years and joined JNTU College of Engineering, Anaparthi as Assistant Professor. After working two and half years in JNTU, he moved to University College of Technology, Osmania University (in 1997) as Associate Professor and subsequently he got promoted as Associate

Professor and subsequently he got promoted as Professor in 2005. Till then he has been serving in teaching and research in the college and university level. He has been working in various capacities like Dean, Faculty of Technology, OU, Head, Department of Technology, Vice Principal, UCT, OU, Chairman, BOS Technology, Officer incharge of Examinations etc. He is also Coordinator, TEQIP and Principal Investigator for CoE under TEQIP. He is presently Dean, Faculty of Pharmacy and Head, Department of Pharmacy, OU.

He has published 25 Papers in national and 28 Papers in international very reputed Journals and attended 33 seminars and 08 international conferences to present his Research Work. To his contributions he was honored with Young Scientist Award by Andhra Pradesh Council for Science and Technology (APCOST) during 1999. He was awarded 5th position out the TEN as “The Best Professors” by student community in the Survey conducted by M/s. 24/7 Customer in Education for the year 2008. In CHEMCON 2009, he received “The Hindustan Lever’s The Outstanding Chemical Engineer of the Year 2009 (under 45 years)” Biennial Award. He visited United States of America, Canada, Germany and Singapore for collaborative research work. Process Intensification, Circulating Fluidized Bed Technology, Reactive Separations and Waste Water Treatment are his interesting research areas. He completed two AICTE projects and one DST-PURSE project. At Present, he is actively working as Principal Investigator to establish Centre of Excellence Laboratory in Process Intensification under TEQIP. He supervised 10 Ph Ds and guided 45 M. Tech theses.

Dr.Jyothi Thati: Course Coordinator



Dr. Jyothi Thati obtained BTech (2001), M.Tech (2003) from University College of Technology (A), Osmania University, Hyderabad and PhD (2011) in Chemical Engineering from Royal Institute of Technology (KTH), Sweden. After completing PhD worked as a researcher at ISPT (Institute for Sustainable Process Technology), Netherlands. After completing Post Doc moved to India and started working at University College of Technology (A), Osmania University.

Currently working as a Principal Investigator funded by DST under WOS-A Scheme at UCT, OU, Hyderabad performing teaching as well as research activities. In last years she taught courses on process equipment design, chemical reaction engineering, chemical reactor design and analysis on the Bachelor and Master level. Particle Engineering and Process Intensification are main area of Research interests.

For further details contact

Course Co-Ordinator

Dr. Jyothi Thati

Principal Investigator

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