# MTech Admission 2023-24

## Department of Chemical Engineering, IIT Hyderabad


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# MESSAGE

The Department of Chemical Engineering at IIT Hyderabad (ChE@IITH) is one of the fastest growing Chemical Engineering Departments in the country and has an excellent reputation in teaching and research, built over the last 14 years. With 23 faculty members engaged in cutting edge research, we provide quality programs in chemical engineering education, research, and expert consulting support to process industries.

***"To deliver world-leading research, education, and inspiration in chemical engineering and practice what we learn as a chemical engineer to serve the country and society at large."***

With IITH standing tall in the NIRF ranking, ChE@IITH is committed to set new heights for excellence in engineering education and research. We will achieve this ambitious goal by (i) instilling our fractal teaching approach which provides our students the extreme flexibility of need based learning, (ii) amalgamating the theoretical concepts and practical training of chemical engineering that makes this ever green stream of engineering to be more adorable to our students, (iii) attacking the hard pressed social problems through an interdisciplinary research approach, helping our students and faculties to become more socially responsible citizens, (iv) implanting the culture of productization and start-up in the young minds of our students to think big and green for future, and (v) making high quality education accessible to the citizens of the country at their ease.

**Professor Kishalay Mitra**
**HOD, ChE**
**e-mail: head@che.iith.ac.in**

# VISSION, MISSION AND AIMS

## Our Vision

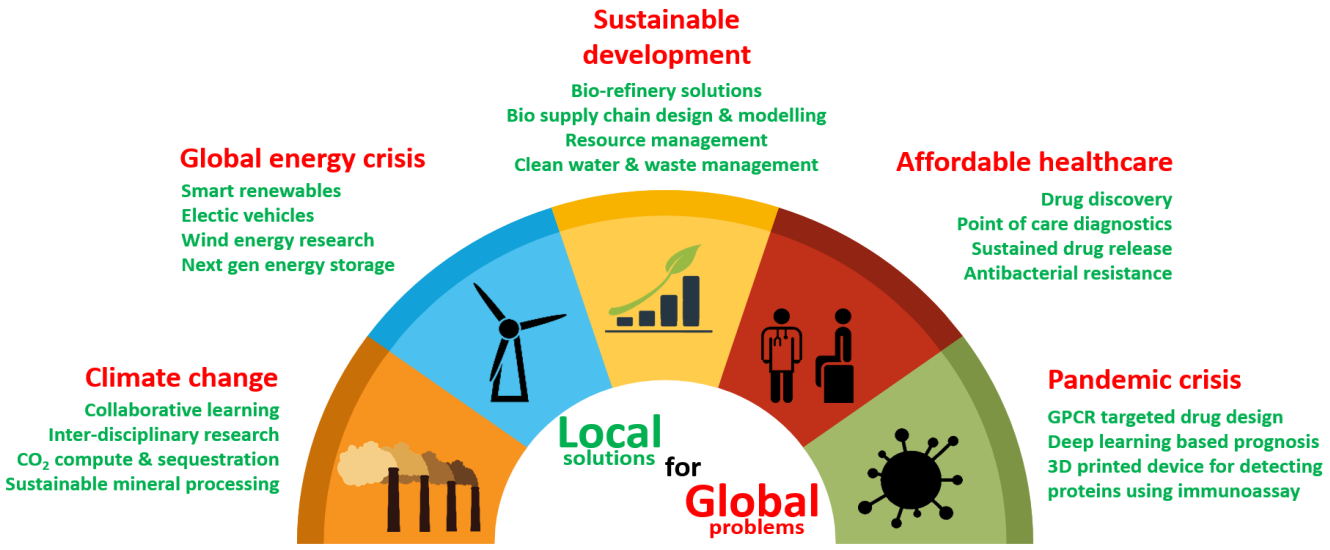
To be recognized by academia and industry worldwide as the leading Indian Chemical Engineering Department and a preferred place for students to learn, recruiters to recruit, faculty and staff to join and serve the country.

## Our Mission

To deliver world-leading research, education, and inspiration in chemical engineering and practice what we learn as a chemical engineer to serve the country and society at large.

## Our Aims

The Department of Chemical Engineering's aim is to make the world a better place through Research and Education, in line with the overall Institute strategy. We strive to deliver world leading research, education and leadership in chemical engineering and its transformational application to industry and society.



# ACADEMIC PROGRAMS

The Department of Chemical Engineering, IIT Hyderabad offers BTech, MTech and PhD programs to prepare them to become leaders of tomorrow who can transform the chemical industries to solve the socio-economic problems in a sustainable manner. The core of the undergraduate curriculum is designed to build strong foundations in chemical thermodynamics, reaction kinetics, fluid mechanics, process control, and principles of mass and transfer. The Department also offers advanced compulsory courses to strength their fundamentals to an even higher level. The Department also offers a large number of electives in the areas of energy and environment, advanced materials, CFD, chemical processes and biological engineering, mineral processing, soft matter, multiphase flow, AI&ML, atomistic simulation and bioengineering and systems biology. The advanced electives along with training on live projects prepares our students to address problems that cut across the boundaries of conventional chemical engineering.

## B.Tech

### B.Tech

**Features:**

- Total credit requirement is 129.
- B.Tech (Hons) is also offered by the department.
- A project work is compulsory for B.Tech (Hons) students
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**Duration:** 4 years (8 Semesters)
**Entrance:** Admission through JEE Advanced

### Dual Degree (B.Tech + M.Tech)

**Features:**

- A student can choose to continue for higher program by converting to dual degree.
- Master thesis is compulsory for all dual degree student.
- Dual degree students are eligible to receive fellowship in last two semester as per regular MTech student.

**Duration:** 5 years (10 Semesters)
**Entrance:** Admission through JEE Advanced

# ACADEMIC PROGRAMS

## MTech

### Regular MTech

**Features:**

- Total credit requirement is 52, which includes 17 core courses, 7 electives, and 4 laboratory courses.
- M. Tech thesis credit requirement is 24.
- Several M. Tech thesis topics are motivated by industry.
- Industry lectures have been introduced in the M. Tech curriculum to get the students acquainted with different topics of industry interest.

**Duration:** 2 years (4 Semesters)
**Entrance:** Admission through GATE. IIT graduate with minimum CGPA 8.0 without GATE score.

### Self-sponsored MTech

**Features:** Self sponsored MTech is a non-subsidized master's degree program. Academic requirement is similar to the regular MTech program. Candidates are required to pay tuition fees on a per credit basis. Such candidates are not eligible for financial assistantship under MoE.

**Duration:** 2 years (4 Semesters)
Entrance: Minimum CGPA 7.0 and based on the performance in written test and or interview.

## PhD

### Direct PhD

**Features:** Total credit requirement is 24.
**Duration:** 5 years with Fellowship
**Eligibility criteria:** B.E/B.Tech with valid GATE Score, MSc with UGC/CSIR NET Score and with department specified CGPA

### External/ Sponsored PhD

**Features:** Total credit requirement is 24. Candidates from national laboratory, academics and industry are eligible.
**Duration:** 5 years with no fellowship
**Eligibility criteria:** M.E/M.Tech degree with minimum 2 years of experience.

### Regular PhD

**Features:** Total credit requirement is 12.
**Duration:** 5 years with Fellowship
**Eligibility criteria:** M.E/M.Tech with department specified cut off CGPA or equivalent.

IITH project sponsored candidates are also eligible to apply.

# RESEARCH AREAS

Research spans a wide variety of exciting areas including fluids, mineral processing, catalysis, materials for energy and biological applications, nanotechnology, bioengineering, process control, optimization, microfluidics, and DFT studies. The department now hosts about 60 PhD students. Our strong commitment to research is evidenced by INR 30 crores extramural funding that our faculties have obtained. Faculties are actively involved in hosting conferences and outreach workshops benefitting the students and faculty across several institutes in India. The Department also houses state of the art research and teaching equipment. Faculty productivity is indicated by their publication record in leading journals.

## Energy

The energy research in the Department of Chemical Engineering spans across bio-fuels to fuel processing to fuel cells and batteries. The faculty members are actively involved in Solid Oxide Fuel Cell (SOFC) research and onboard fuel processing for SOFC-auxiliary power unit applications along with design and materials aspect of rechargeable batteries.

## Catalysis

Our research is also focused on the design and development of catalyst materials – ranging from zeolite and supported metal/metal oxide – with improved reactivity, stability, and selectivity. The catalysts are tested for various industrial processes (e.g., steam reforming, water-gas shift reaction, and fine chemicals) and biomass-based fuels and chemicals. This study aims to produce hydrogen, biofuels, and value-added chemicals and utilizes renewable feed stocks, low-value by-products, and waste materials. The design and optimization of chemical processes using Aspen Plus are also an integral part of this research. An integrated approach considering experimental, and density functional theory (DFT) calculations is applied for rational design of catalyst.

## Fluid Mechanics

We pursue research on a variety of problems of fundamental and applied interest in fluid mechanics, and heat and mass transfer using a combination of tools ranging from basic

# RESEARCH AREAS

modeling, computational fluid dynamics (CFD), and linear stability analysis. Fluid mechanics research conducted in the department spans a wide range of topics such as multiphase flows, spatially developing flows in complex geometries, micro-fluidics, and biological flows. A major focus of our research is on understanding the transition to turbulence, with high emphasis on the laminar-turbulent transition.

## Mineral Processing

In mineral processing research, we are involved in flow sheet development and optimization for various mineral beneficiation plants. We study dense medium cyclones (DMC), hydro-cyclones (HC), feed slurry distributors, grinding mills and flotation devices for understanding the process by using computational modeling techniques (multi-phase CFD/discrete element methods/coupling CFD-DEM models). New innovative/novel improved mineral processing equipment designs through integrated CFD/DEM studies and physical modeling is our major focus. Mathematical models based on industrial data and inputs from CFD/DEM are also being developed using non-linear model building techniques for various mineral processing units.

## Molecular and Cellular Bioengineering

The key to understanding the role of chemical engineers in biological engineering research is to recognize that biological systems are inherently chemical in nature. Chemical Engineering provides a unique integrated systems perspective across a wide range of length scales (molecular to macroscopic) that makes it well suited to attack problems of great interest in modern biology. Specifically, the thrust of our research is on developing a mechanistic understanding of intercellular interactions involved in pathophysiological processes such as infection, inflammation, thrombosis, and cancer metastasis. In addition, our efforts are focused on developing multi-scale computational models for vascular processes such as leukocyte rolling over the endothelium, and bulk phase intercellular interactions in blood flow.

# RESEARCH AREAS

## Haemodynamics and Haemostasis

Pathologies of the cardiovascular system due to coagulation abnormalities are greatly influenced in their progression by the mechanics of vascular tissue, by the flow behavior of blood in blood vessels, and by the biochemistry of the reactions in the coagulation cascade and fibrinolysis. The thrust of our research is to better understand these pathologies by characterizing the rheological and biochemical variables in flow situations that present in the human vasculature, and by identifying conditions that precipitate potentially life-threating events (like thrombo-embolisms and strokes). Towards this end, we use various tools like computational modeling of blood flow in the presence of clot formation and lysis, experimental characterization of blood and clot rheology, and constitutive modeling of blood, clot, and vessel walls.

## Drug Delivery

Many newly developed specialized polymers are increasingly being applied for delivering drugs in more controlled and sustainable way. In this important area of application, an effort is going on at IITH to develop new methods and mechanisms to achieve 'controlled, targeted and sustainable release of drugs' with the help of specialized polymers. We are also interested in investigating the fundamental forces between the polymer and drug molecules at various conditions.

## Nanoscience and nanotechnology

Nanoscience and nanotechnology is a rapidly emerging interdisciplinary field at the interface between physics, chemistry, materials science, electronics, and biology. Broad activities in this fast-changing arena of research include synthesis of a wide range of nanomaterials, their characterization and applications in energy and environment. Presently, we focus on synthesis, fabrication of carbon-based nanostructures and their applications in energy storage devices such as Li ion rechargeable batteries etc. We also deal with nanopatterning of soft matters for various applications such as superhydrophobic surfaces.

# RESEARCH AREAS

## Process control and Stochastic Control

Process Control deals with the use of automatic control strategies to improve efficiency of a chemical process. Apart from the applications of standard control techniques, we develop novel sensor technologies (known as "soft sensors") based solely on data obtained from a running plant. For example, the data could be in the form of images, sound or just input output data of a process stored in a chemical plant. We also study the application of non-linear and stochastic control techniques.

## Polymers

Conventional polymers are currently facing a lot of issues related to the environment as well as their petroleum origin. Our research program aims to address these aspects by coming up with new grades of environmentally friendly polymers and/or building knowhow of making biodegradable polymers with customized features for specific applications. The focus is on building polymerization technology through modeling, optimization, and lab-scale implementation and then optimally linking with rheology and processing with desired end use properties. Our program also includes research on other polymeric soft materials such as colloids and biopolymers where we are integrating fundamental, and application driven projects to efficiently create advanced materials of tunable properties.

## Machine Learning in Process Systems Engineering

Recent improvements in infrastructures and their affordability, automation, ubiquitous connectivity resulted in generation, processing, and management of enormous amounts of heterogeneous data in the domain of Process Systems Engineering (PSE). The research in this direction is to investigate how deep supervised / unsupervised learning methods can be used to solve PSE problems (e.g., surrogate optimization, system identification and control, image-based sensing, uncertainty quantifications, optimal control) more efficiently. Targeted applications are wind farm layout optimization, new alloy discovery, monitoring climate change parameters, fast charging protocols in Li+ battery, bio-fuel supply chain, systems biology to name a few.

# RESEARCH FACILITIES

## Experimental Facilities

- FTIR Spectrometer
- UV-vis NIR Spectrometer
- Powder X-ray diffractometer
- Physisorption analyzer ($N_2$ isotherm, BET measurement)
- Chemisorption analyzer (TPR/TPD)
- Thermogravimetric Analyzer
- LC-MS
- GC-MS
- Gel Permeation Chromatography
- Gas Chromatography
- Confocal Microscope
- SAXS
- Optical microscope
- Differential scanning calorimetry (DSC)
- Optical tweezer
- AFM
- HPLC
- Goniometer
- Nano indentation
- Tabletop SEM
- Rheometer
- 2D micro-PIV
- Langmuir Blodgett
- 3D Printer
- Ultra-low temperature freezer
- CHNSO analyzer
- Multiplex array reader
- Ion chromatography
- Cell counter
- Flow cytometer
- Impedance analyzer
- Battery testing Machine
- Mask Lithography
- Micron particle size analyzer
- Electrical capacitance volume tomography (ECVT)
- Electrical resistance tomography
- 2D LDA
- Circular dichroism spectrometer/ polarimeter
- 3D optical profiler
- Dynamic light scattering (DLS)
- Microwave plasma atomic emission spectrometer (MPAES)
- High speed Camera
- Flir imaging system
- Fixed bed reactor
- High pressure and temperature batch reactor (Parr Inst.)
- Bioreactor
- Fermenter

## Computational Facilities:

Department has several high-end workstation and computer cluster.

**Software:** MATLAB, Material studio, Aspen Plus, Fluent-Ansys

# ELIGIBILITY CRITERIA

## Regular MTech

Department of chemical engineering offers two-year regular MTech program with teaching assistantship.

- Admission in regular MTech is based on GATE score. Candidates with valid GATE score in **GATE paper CH and BT** are only eligible to apply.
- Candidates should have a bachelor's degree (B.E./B.Tech) in Chemical Engineering, Chemical Technology (petroleum, petrochemical, polymer/rubber, oil, pharmaceutical etc.), Biotechnology, or related disciplines from a Govt. recognized educational institution/university.
- Candidates who are in their final semester of bachelor program may also apply, provided that their results are likely to be declared by July 15, 2023.
- IIT graduates with BE/BTech degree in Chemical Engineering and relevant discipline securing minimum CGPA of 8.0 can apply without a GATE score.

## Self-sponsored MTech

The Department of chemical engineering offers a two-year self-sponsored MTech program.

- Candidates with B.E./B.Tech from a government recognized university/institution with minimum CGPA 7.0 (70% marks) in Chemical Engineering, Chemical Technology (petroleum, petrochemical, polymer/rubber, oil, pharmaceutical etc.), Biotechnology, and related disciplines are eligible to apply under self-sponsored category.
- Valid GATE score is not required for this program.

## Reservation policy

Govt. specified reservation policy is strictly followed during selection and admission under regular MTech. 15% seats for SC candidates, 7.5% for ST, 10% EWS and 27% for OBC are reserved in regular MTech program. Candidates are advised to apply with the relevant category certificate from competent authority.

# FINACIAL ASSISTANCE

- Financial assistance in the form of Half-Time Teaching Assistantship (HTTA) at the rate as per MoE guidelines will be awarded to Indian nationals enrolled in the regular MTech Program with valid GATE score, subject to Institute rules.
- HTTA students are required to assist the department for 8 hours of teaching assistance (TA) work per week. The TA works are related to academic activities of the department such as laboratory demonstration, tutorials, evaluation of assignments, quizzes, seminars, research projects etc.
- Candidates under self-sponsored category are not eligible for financial assistance.

# OPPORTUNITIES AFTER MTECH

## Placement

The department of Chemical Engineering at IITH offers a state-of-the-art curriculum for its students at all levels to prepare them to become leaders of tomorrow who can transform the chemical industries to solve the socio-economic problems in a sustainable manner. Some of our past recruiters (both on and off campus) are BPCL, IOCL, Maruti Suzuki, Phone Pe, Coromandel, Hindustan Zinc, Tata Motors, NEC Technologies, Open World, TCS R&D, Vedanta, Helium Consulting, Nagarjuna Fertilizer, Aurobindo Pharma, Pokarna, Wells Fargo, Perceptive analytics, Virtusa, Entransys, HPCL, Geny Medium and Deloitte.

## MTech to PhD conversion

Highly motivated candidates with excellent academic achievements can convert their MTech program to PhD program in the department. The interested students are encouraged to apply.

## Higher studies in abroad

Motivated students take the opportunity to do doctoral research in various reputed university around the world. IIT Hyderabad has strong collaboration with various Japanese universities through JICA. Every year interested students enroll for PhD program with various Japanese universities through JICA.

# APPLICATION PROCEDURE

## Application fee

The details of application fees and payment mode for all categories candidates are given in IIT Hyderabad MTech admission web portal.

## Online Application

Candidates need to apply online through the online MTech admission web portal. The instructions related to filling up the online application form are available in the MTech admission web portal.

# SELECTION PROCEDURE

- Regular MTech program with valid GATE score: The admission is based on GATE score.
- Self-sponsored MTech program: The candidates will be selected based on the performance in the written test and/or personal interview.
- Direct admission: Graduates of IITs with minimum CGPA of 8.0 without GATE score are eligible to apply. Department may conduct written test or interview for their selection.

# CONTACT

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