



PhD Admission 2023-24

Department of Chemical Engineering, IIT Hyderabad

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Indian Institute of Technology Hyderabad

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 22 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 mind 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.

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VISSION, MISSION AND AIMS

Our Vision

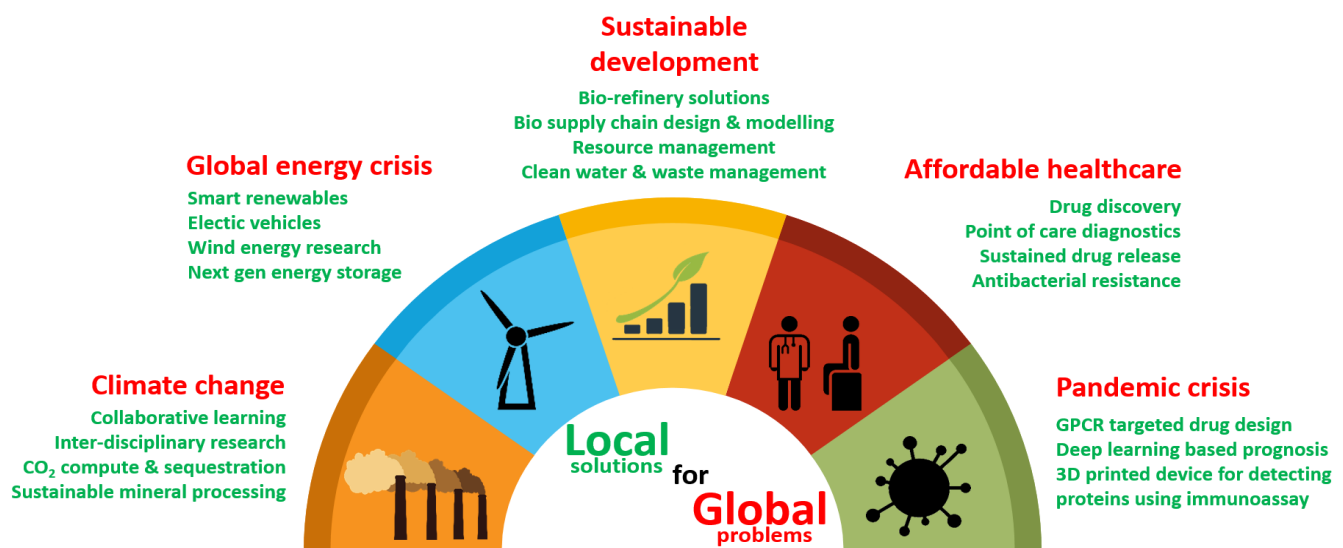
To be recognized by academia and industry worldwide as the leading Indian Chemical Engineering Department and a preferred place for students to learn, recruiters to recruit, faculty and staff to join and serve the country.

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 mission 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 matters, multiphase flow, AI&ML, atomistic simulation and bio-engineering and system biology. The advanced electives along with training on live projects prepares our students to address problems that cuts 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
- Students can opt for ChE as minor or major through earning specified additional credits.

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 the 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 nonsubsidized master's degree program. Academic requirement is similar to the regular MTech program. Candidates are required to pay tuition fees on per credit basis. Such candidates are not eligible for financial assistantship under MHRD.

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. Both MTech and PhD degrees will be awarded at the end.

Duration: 5 years with Fellowship

Eligibility criteria: B.E/B.Tech with GATE qualified, MSc with UGC/CSIR NET and department specified cut off CGPA.

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.

External/ Sponsored PhD

Features: Total credit requirement is 12. Candidates from national laboratory, academics and industry are eligible.

Duration: 5 years with no fellowship

Eligibility criteria: A minimum 2 years of experience for all below category.

- External Regular PhD: MTech/ME degree with department specified cut off CGPA or equivalent.
- External Direct PhD: BE/BTech/MSc with department specified cut off CGPA or equivalent. However, such candidates will be awarded PhD degree without MTech.

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, CO₂ conversion and fine chemicals) and biomass-based fuels and chemicals. These study aims to produce hydrogen, bio-fuels, 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 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-threatening 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 environment friendly polymers and/or building knowhow of making biodegradable polymers with customized features for specific applications. The main 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 (N₂ 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

Direct PhD

The Department of chemical engineering offers a direct PhD program with financial assistance for highly motivated undergraduate students with excellent academic achievements.

- Candidates with BE/BTech degree from govt recognized institute/university in Chemical Engineering or allied field with GATE qualified (CH, BT, BM, PE, ME and XE with paper Fluid Mechanics, Polymer Science and Engineering, and Material Science, GATE paper) are also eligible to apply.
- CGPA requirement: minimum of 6.0 CGPA or 60% marks for general, 5.5 CGPA or 55% for other categories such as OBC/SC/ST in the qualifying degree.
- Candidates with MSc degree with valid CSIR/UGC NET fellowship are encouraged to apply. CGPA requirement: BSc and MSc with minimum of 6.0 CGPA (60%) for general, 5.5 CGPA (55%) for other categories such as OBC/SC/ST.

Regular PhD

Department of chemical engineering offers regular PhD program with financial assistance.

- Candidates with MTech/ME degree in Chemical Engineering are eligible to apply. GATE qualified is not a pre-requisite.
- Candidates with MTech/ME degree in allied engineering disciplines such as Mechanical Engineering, Material science and Engineering, Chemical Technology (Polymer, Petroleum, Petrochemical etc.) Biomedical Engineering, Biotechnology and Mineral processing and Engineering are also eligible to apply.
- Candidates with fellowships from an external funding agency (e.g., DST inspire) are encouraged to apply.
- Candidates working in a sponsored project at IITH can apply under this category.
- CGPA requirement: BE/BTech in Chemical Engineering or allied discipline with 60% marks for general, 55% for other categories such as OBC/SC/ST and ME/MTech in Chemical Engineering or allied discipline minimum of 6.0 CGPA (60%) for general, 5.5 CGPA (55%) for other categories such as OBC/SC/ST.

External/Sponsored PhD

- Candidates from national research laboratories/academic institutions/reputed industrial organizations are encouraged to apply under this category.
- A minimum of two years of research /teaching experience for all below category is required.
- **External Regular PhD:** Candidates with MTech/ME degree in Chemical Engineering or allied engineering disciplines such as Mechanical Engineering, Material science and Engineering, Chemical Technology (Polymer, Petroleum, Petrochemical etc.) Biomedical Engineering, Biotechnology and Mineral processing and Engineering are eligible to apply. **CGPA requirement:** BE/BTech in Chemical Engineering or allied discipline with 60% marks for general, 55% for other categories such as OBC/SC/ST and ME/MTech in Chemical Engineering or allied discipline minimum of 6.0 CGPA (60%) for general, 5.5 CGPA (55%) for other categories such as OBC/SC/ST.
- **External Direct PhD:** Candidates with BE/BTech/MSc from govt recognized institute/university in Chemical Engineering or allied field are also encouraged to apply. **CGPA requirement for BE/BTech:** minimum of 6.0 CGPA or 60% marks for general, 5.5 CGPA or 55% for other categories such as OBC/SC/ST in the qualifying degree. **CGPA requirement for MSc:** BSc and MSc with minimum of 6.0 CGPA (60%) for general, 5.5 CGPA (55%) for other categories such as OBC/SC/ST.

Note: Department of Chemical Engineering reserves the right to set a different criterion which can be equal or above the eligible criteria for shortlisting the candidates for the selection process.

Category of admission

- **Full time Institute Fellowship (MoE)**
- **Fellowship from external funding agency:** Candidates with valid DST Inspire, CSIR/UGC NET etc. fellowships are encouraged to apply.
- **Sponsored project:** Candidates working in a sponsored project at IITH can apply under this category.
- **External/Sponsored PhD:** Industry, Research Laboratory and Academic Institution sponsored candidates with a minimum of two years of research /teaching work experience.

Reservation policy

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

FINACIAL ASSISTANCE

- Candidates admitted to the PhD program under direct and regular scheme (full-time) are eligible for financial assistance from institute (Teaching assistance TA).
- Candidates with TA 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.
- Renewal of assistance every semester will be contingent on enrolment, satisfactory progress, and performance in the preceding semester.
- Candidates admitted under various sponsored categories are not eligible for financial assistance from the Institute. However, they are eligible to receive financial assistance from projects (IITH) or sponsoring academic and research institutes, industry etc.

APPLICATION PROCEDURE

Application fee

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

Online Application

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

SELECTION PROCEDURE

- Candidates are admitted based on the performance in written test and/or interview. Depending on the number of applicants, the department reserves the right to conduct a written exam or subject oriented interview for initial screening.
- The purpose of the interview is to gauge fundamental knowledge in Chemical/relevant engineering and research aptitude of the candidates. In general, candidates will be tested for clarity of thought, analyzing skills, confidence level, and passion for research.

- The written test and interview are likely to be performed in the same day or spread over to few days based on the number of shortlisted candidates.

AFTER PhD ADMISSION

Courses

The PhD candidate is required to undergo course work during the first two semesters. The typical course requirement in the department is 12 credits, with a minimum cumulative grade point average of 7.0. The candidates, in consultation with their supervisor, may also choose to take relevant courses from other departments. **Candidates with BE/BTech and MSc degree will have to do extra credits as per institute policy.**

Guide selection

The candidates are allocated supervisor either at the beginning of first semester or the end of the first semester based on the student's choice. PhD candidates are encouraged to discuss with department faculty members working in research areas of interest. PhD candidates are required to provide names of faculty members whom they wish to work with, listed in order of preference. The supervisor is allocated based on the preferences received from all PhD candidates.

Comprehensive exam

Candidates must appear for the comprehensive exam after successful completion of course work and within 12 months from the date of joining the department. Candidates must pass the comprehensive exam in order to continue in the PhD program. Details of the comprehensive exam will be communicated after joining the department.

PhD thesis proposal defense

After successful completion of comprehensive exam, all PhD candidates are required to defend their thesis proposal within 06 months of successfully passing the comprehensive exam or before 18th months from date of joining whichever is earlier. The thesis proposal consists of a written document outlining the research plan, and the candidates must make a presentation before the doctoral committee.

Research progress

PhD scholars are required to regularly apprise the doctoral committee of progress made in solving the research problem. Continued involvement in the PhD program is subject to satisfactory progress, as deemed by the doctoral committee.

CONTACT

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