Interdisciplinary M.Tech. Program
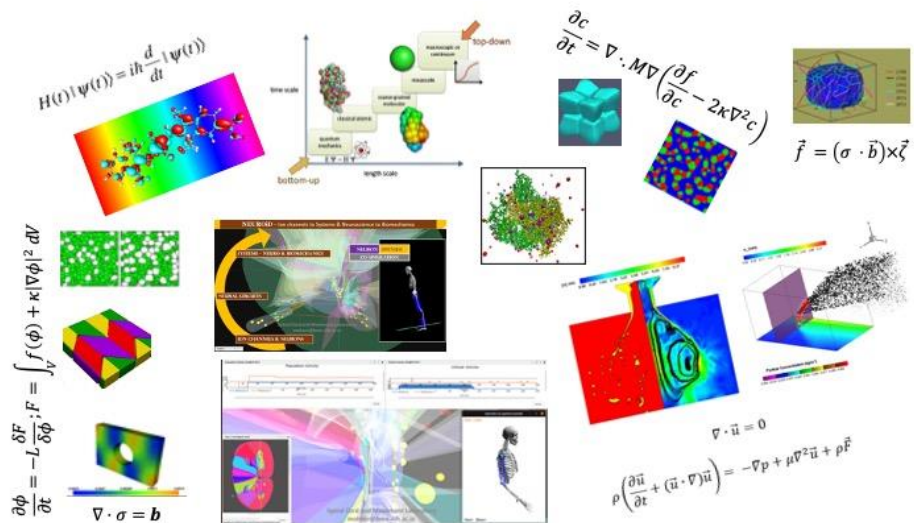
Integrated Computational Materials Engineering

"Integrating computation with experimentation for accelerated materials discovery and development"

Materials Genome Initiative

Unlock Your Potential with IIT Hyderabad's Exclusive Master's in ICME—Designed for Industry Professionals and Research Organizations!

Elevate your career with the master's program in Integrated Computational Materials Engineering (ICME) at IIT Hyderabad, a pioneering interdisciplinary program crafted specifically for professionals in industry and research organizations. This flexible, 48-credit journey is tailored to fit your schedule, allowing completion over four years while you continue to work.

Students are required to complete 24 credits of coursework in a self-defined pace within the first 3 years. Upon completion of coursework, students can do 24 credits of a Capstone Project in collaboration with the industry over a period of one year. If the student is not interested in 24 credits of capstone project, she/he can graduate with an Executive M.Tech. degree in ICME.

Aim and Scope

According to the Vision 2040 report by NASA, advances in high performance computing, high-throughput characterization of materials, integrated computational materials engineering approaches, and additive manufacturing have catalyzed modeling and simulation-based design of materials and systems. The report envisages "a cyber-physical-social ecosystem that impacts the supply chain to accelerate model-based concurrent design, development and deployment of materials and systems throughout the product lifecycle …". This course teaches the essential tools required to build such a cyber-physical ecosystem and is particularly relevant when more industries are adopting Industry 4.0 and Smart Manufacturing.

The purpose of this course is to teach professionals from various industries an accelerated approach to design materials and products concurrently and synergistically. This course aims to teach the principles of materials design, modeling tools at multiple length-scales and timescales and their applications in linking processing-structure-property-performance relations in materials to address issues related to product design and application.

Students will receive an interdisciplinary education where they gain expertise in various ICME techniques and tools, multiscale modeling of materials, high-performance computing, optimization, data analytics and machine learning for accelerated design of materials and processes.

The course will involve numerous examples and case studies, hands-on tutorials, computational thinking and problem-solving, and lectures from Industry experts.

Curriculum

The curriculum is designed to provide state-of-the-art knowledge of ICME with an emphasis on problem-solving and hands-on development and implementation of computational models and simulations for materials design. Some of the major courses are as follows:

- Materials Engineering Principles
- Introduction to ICME Techniques and Tools

- Optimization and Machine Learning in Materials Science – data-driven modeling of process-structure-property-performance relations
- Finite Element Modeling
- Computational Thermodynamics and Kinetics of Materials
- Electronic Structure and Atomistic Simulation Methods for Materials Design - their applications in materials design
- Mesoscale Microstructural Modeling-Phase-field modeling, Cellular Automata
- Computational Micromechanics
- Materials Process Modeling (Modeling of Casting, Forming and Joining Processes)
- Concurrent and Parallel Programming
- Information and Tools Integration for ICME (taught by Expert from Industry)
- Clean-steel Making: Theory, Practice, and Modeling

Course Mode

The courses will be offered in hybrid/fully online mode so that the enrolled students can attend the courses online. All classes and tutorials will be recorded, and the recordings will be available with all enrolled students.

To enhance your learning experience, we also host special interactive sessions. These sessions provide a unique opportunity for you to engage directly with instructors, ask questions, and participate in live hands-on tutorials and coding sessions. It's the perfect blend of convenience and engagement, designed to make your learning journey as effective and enjoyable as possible.

Plan Your Schedule with Ease and Access Learning Anytime!

Before each course begins, we'll provide you with the time slots well in advance. This ensures you have the flexibility to choose your electives according to what best fits your schedule. Throughout your coursework, you'll have unrestricted access to recorded video lectures and tutorials, allowing you to learn at your own pace and revisit material whenever you need.

Our examinations are uniquely designed to hone your analytical and problem-solving skills. You'll be challenged to develop numerical models and algorithms, as well as conceptualize simulation strategies for materials and process design. This approach ensures that you're not just learning theory but also applying it in practical, innovative ways to solve real-world problems

Highlights

- **Flexibility:** Our program is designed to fit your busy work schedule. You gain a world-class education on your terms, without a residential requirement.

- **Hands-On Learning:** Dive deep into practical training with an abundance of hands-on sessions. You'll master the real-world application of ICME tools, tackling industrial challenges head-on. Our curriculum is crafted to make you proficient in cutting-edge software for multiscale modeling of materials, incorporating the latest in artificial intelligence (AI) and machine learning (ML) for innovative materials design.

- **Software Proficiency:** Become an expert in an impressive array of software critical to the field of computational materials engineering. Our program covers Thermo-Calc, DICTRA, TC-Prisma, Ansys, MATLAB, TensorFlow, PyTorch, PRISMS, MOOSE Framework, MicroSim, LAMMPS, Quantum Espresso, Pycalphad, OpenFOAM and so on. Each tool is chosen to ensure you're ready to make an impact in the industry, equipped with knowledge and skills that are in high demand.

Embark on a learning journey with us to transform the world of Materials Science!

Eligibility Criteria

- *This program is for professionals working in the industry or research organization with a minimum of two years of professional experience.*

- *Candidate should have a B.E./B.Tech./M.Sc./B.S.(4yr) or equivalent degree or an M.E./M.Tech./M.S. or equivalent degree in Metallurgy/ Materials/ Ceramic/ Mechanical/ Aerospace/ Manufacturing/ Chemical/ Electrical/ Nanotechnology/ Physics/ Chemistry or any other allied Engineering discipline.*

- *GATE score is not required.*

- *Applicants are required to submit experience and no-objection certificates at the time of written test/interview.*

Selection Process

1. Candidates must fill application online.
2. The selection will be based on the cut-off criteria set by the selection committee and an online interview.

The details of online application procedure along with fee structure is given in: https://iith.ac.in/mtechadmissions/

Course and thesis requirements

- *Credit requirement: Candidates shall earn a total of 48 credits within 4 years from the date of admission into the program. Candidates shall complete the course credits (24 credits) within the first 3 years.*

- *Thesis work: Candidates shall complete the course work in full (24 credits) to start the thesis work. Thesis will have 24 credits, consists of two stages: a) Thesis*

Stage-I: 12 Credits and b) Thesis Stage-II: 12 Credits)).

o *Exit option: After successful completion of the course work in full (24 credits), candidates may opt to leave the program and obtain an Executive MTech Degree.*

o *Candidates are required to carry out their dissertation work using the available facilities/infrastructure in their parent organizations. Every candidate is required to identify a guide from IITH and preferably a co-guide from his/her parent organization.*

Fee Structure

Category	Fee Details
Non-government organizations	*Rs. 25000/- per course credit* *Rs 12500/- per thesis credit* *Semester fee: Rs. 15000/- per semester*
Government organizations, IITH alumni	*Rs. 12500/- per course or per thesis credit* *Semester fee: Rs. 15000/- per semester*