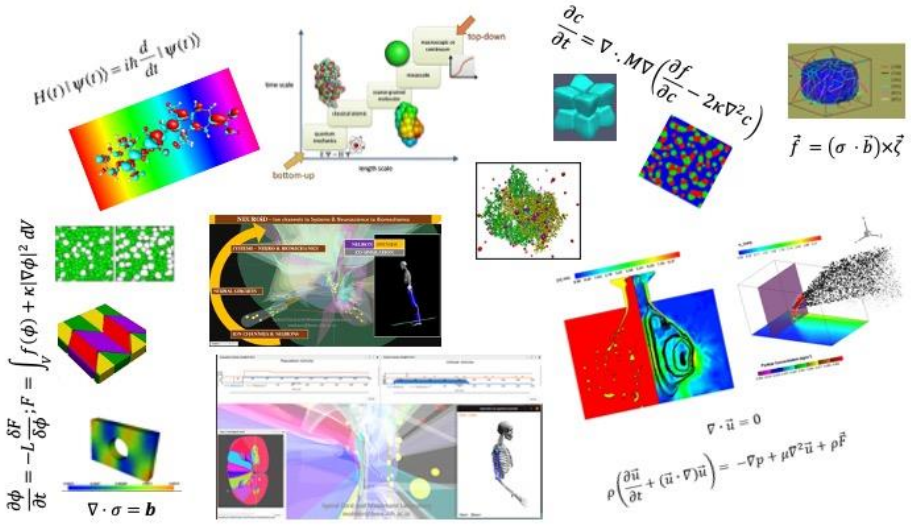
Interdisciplinary M.Tech. Program

Integrated Computational Materials Engineering

Learning by doing, peer-to-peer teaching, and computer simulation are all part of the same equation.

Nicholas Negroponte

The Masters program in ICME at IIT Hyderabad is a unique interdisciplinary program designed exclusively for professionals working in industries and research organizations. It is a self-paced program of 48 credits that can be taken over a period of 2-3 years. Students are required to do 24 credits of coursework where they have the option to choose lesser number of courses in different semesters and complete the course requirement within the first three years. Upon completion of coursework, students will 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 Executive M.Tech. 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:

- Principles of Materials Engineering
- 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 and Computational Solid Mechanics
- Computational Thermodynamics and Kinetics of Materials
- Electronic Structure Calculations and their applications in materials design
- Atomistic Modeling and Simulations of Materials – fundamentals and applications of kinetic Monte Carlo, molecular statics, and molecular dynamics simulations
- Mesoscale Modeling of Process-Structure Relations in Materials (Phase-field modeling, Cellular Automata)
- Computational Micromechanics - Discrete Dislocation Dynamics and Crystal Plasticity
- Materials Process Modeling (Applications of Computational Fluid Dynamics – Modeling of Casting, Forming and Joining Processes)
- Concurrent and Parallel Programming
- Information and Tools Integration for ICME (taught by Expert from Industry)

Course Mode

The courses will be offered in fully-online mode on Monday-Friday from 5:30 pm – 7:00 pm and on Saturday from 9:00 AM – 5:00 PM. The time slots for each course would be sent to students beforehand so that they can accordingly decide their electives. Students will have access to recorded video lectures and tutorials through the entire duration of their coursework. All examinations will be based on analytical and problem-solving skills which will involve development of numerical models and algorithms and conceptualization of simulation strategies for materials and process design.

Eligibility Criteria

1. This program is for professionals working in the industry or research organization with a minimum of two years of professional experience.
2. The candidate should have a BTech/BE or equivalent degree or ME/MTech/MS or equivalent degree in Materials Sci. and Eng./Metallurgy/Mechanical Eng./Production Eng./Ceramic Eng. or any other allied Engineering discipline.
3. The candidate should secure at a CGPA of 7 or 70 pct. marks in one of the qualifying examinations.

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.