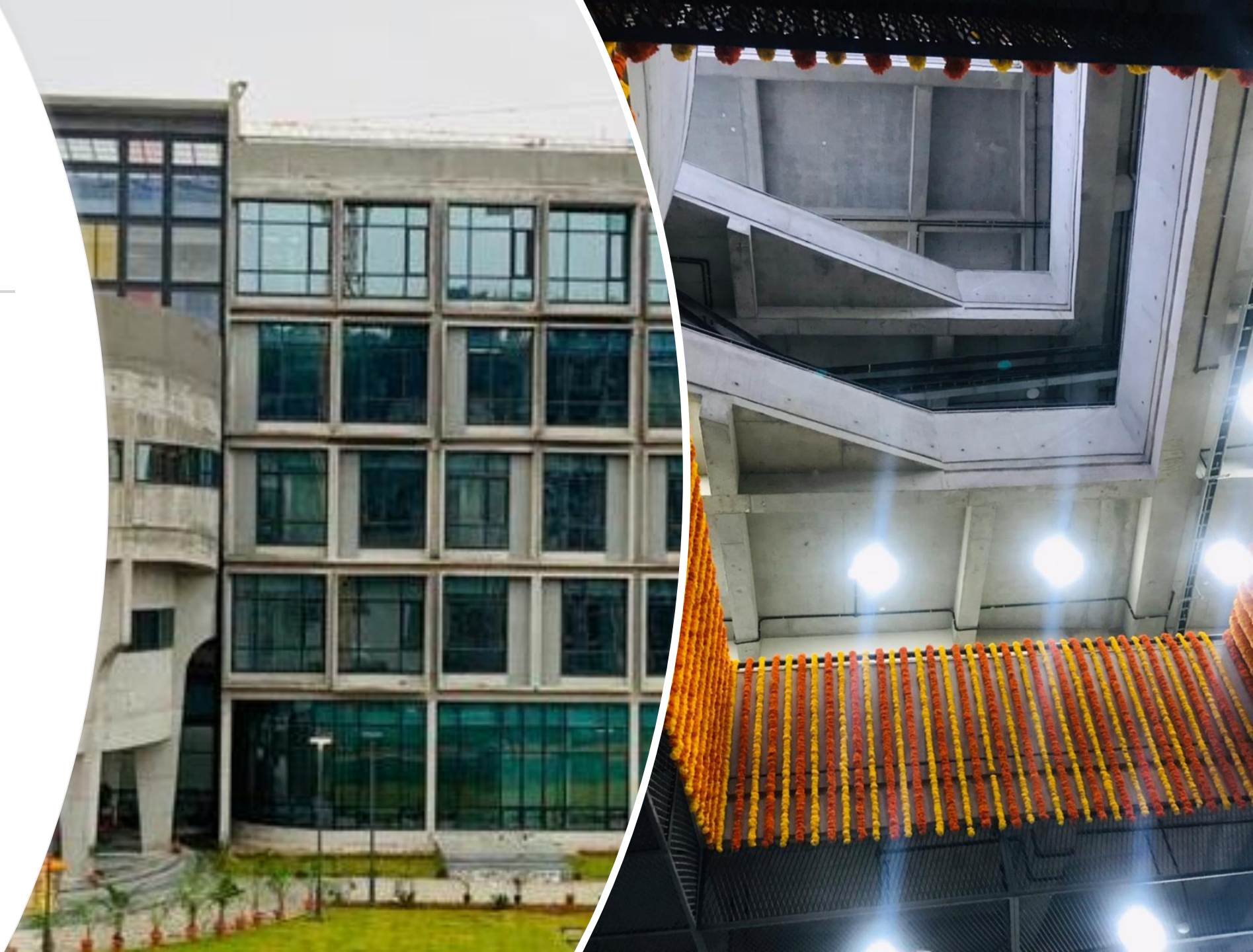
Ph.D. Admissions: January 2025

Materials Science & Metallurgical Engineering

https://msme.iith.ac.in/



MSME Ph.D. Programme

The Doctor of Philosophy (Ph.D.) program is for enthusiastic students with strong analytical skills and very good academic backgrounds willing to take up challenging research problems in various areas of Materials Science and Metallurgical Engineering. Research areas include design and development of novel materials for structural and functional applications, development of novel characterization procedures, computational materials science and materials informatics, development of novel processing techniques, metal additive manufacturing, metal joining, electrochemical materials processing, novel semiconductor fabrication, spintronics, plasmonics, multiferroics and so on.

Selection process

Shortlisted candidates will be called for the selection process.

Selection will be conducted based on written test and/or interview.

visit www.iith.ac.in for more information and apply online

Contact details

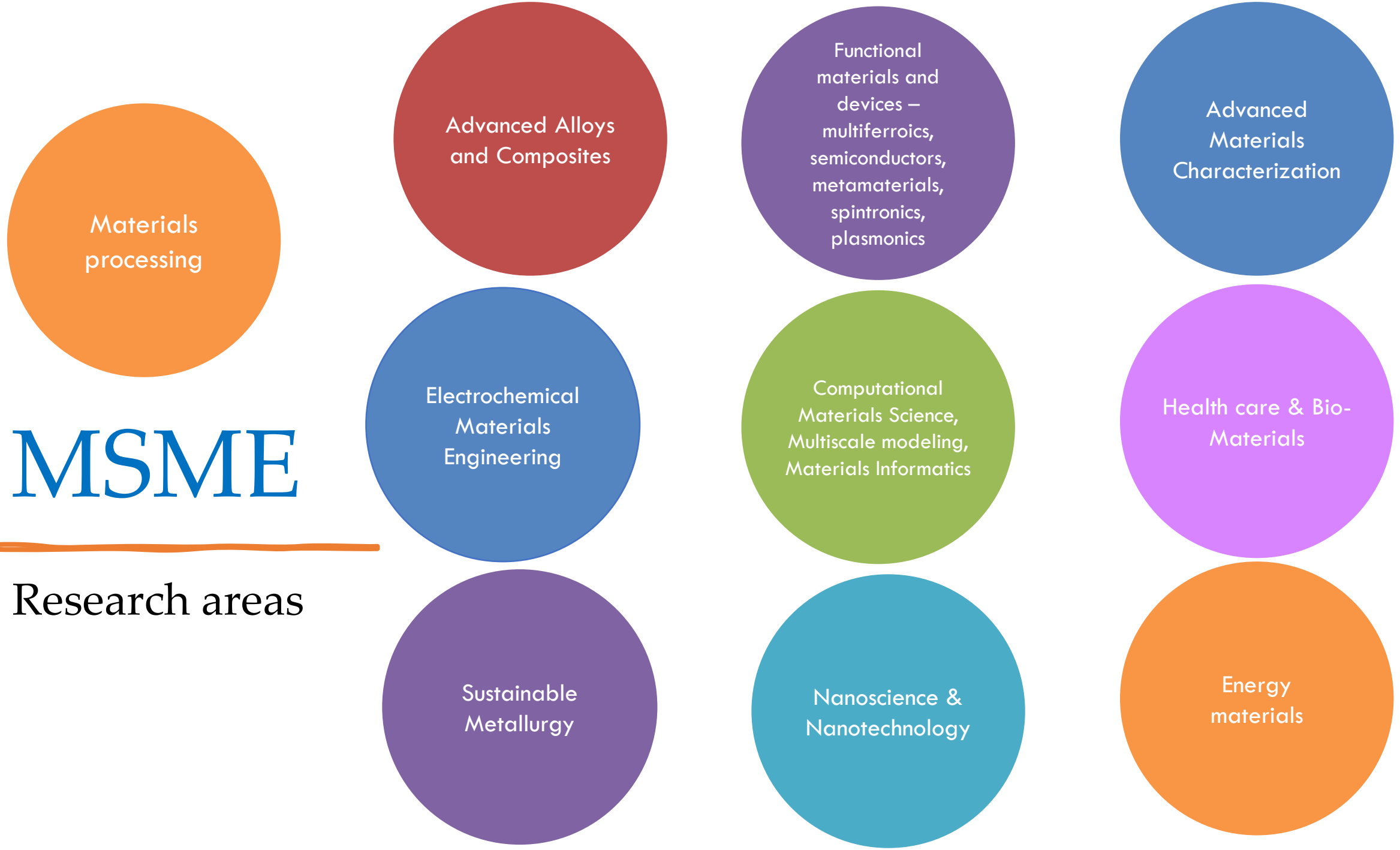
MSME Ph.D. Admissions Committee

Department of Materials Science & Metallurgical Engineering

Email: phd.admissions@msme.iith.ac.in

MSME

Research areas



Facilities at MSME

Materials Synthesis and Processing

- Pulse Laser Deposition
- E-beam deposition
- Planetary Ball mill
- Rolling mill
- Robotic GTA welding
- Uniaxial Compaction Press
- Cold-Isostatic Press
- Induction-melting furnace
- Arc-melting furnace
- Electrochemical Workstation
- Spin and Dip coater
- Sputtering
- Hot press
- High Temperature Vacuum Furnace
- Infra-red heating furnace
- Muffle and tube furnaces
- Salt-bath furnace
- Autoclave Ovens
- Incubator shaker
- Freeze drier
- Bio-safety cabinet
- Glove-box

Computational

- Thermo-Calc
- DICTRA
- TC-Prisma
- COMSOL Multiphysics, ANSYS
- CrystalMaker Suite
- VASP
- State-of-the-art GPU clusters
- Inhouse NSM Supercomputing facility ParamSeva
- MicroSim

Characterization

- Cold FEG-TEM
- FEG- SEM with EBSD
- Optical Microscopes
- FIB
- Ion-milling, PIPS
- SPM
- Surface area and porosity analyser
- Powder & thin film XRD
- UV visible spectrophotometer
- Raman spectrometer
- DTA, DSC, TGA, Dilatometer
- Universal testing machine (MTS, Instron)
- Creep Testing
- Hardness Tester
- Wear (Pin-on-disk)
- Nanoindentor
- Electrochemical analyser
- Viscometer

MSME Faculty

Prof. G.D. Janaki Ram

- Welding
- Additive manufacturing

jram@msme.iith.ac.in +91 (40) 2301 6565

Prof. B. S. Murty

- Nanocrystalline materials
- Thermodynamics & kinetics of phase transformations
- High entropy alloys
- Bulk metallic glasses
- TEM and atom probe tomography

bsm@msme.iith.ac.in +91 (40) 2301 6001

Prof. Bharat B. Panigrahi

- Powder Metallurgy & Sintering Mechanisms
- High Entropy Alloys, MAX Phases and MXene,
- Advanced ceramics & composites
- Microstructure-Mechanical Properties of Steels
- Metal Additive Manufacturing,
- Electro-Spark Coating, Wear & Tribology

bharat@msme.iith.ac.in +91 (40) 2301 6555

Prof. Pinaki P. Bhattacharjee

- Design and Development of High Entropy Alloys
- Development of metallic alloys for advanced and emerging applications
- Materials processing, microstructure, and crystallographic texture
- Bulk ultrafine/nanostructured and heterogeneous materials
- Application of high-resolution Electron Back Scatter Diffraction (EBSD) and Transmission Electron Microscopy (TEM) in materials characterisation.
- Mechanical properties of materials

pinakib@msme.iith.ac.in +91 (40) 2301 6551

Prof. Suhash R. Dey

- Electrochemical Materials Processing
  - Green/Bio Hydrogen production, reduction of CO_2 & N_2 via photo-electrocatalysts design
  - Bioelectrochemical treatment of industrial effluent
  - Electrochemical/Microbial Recovery & Recycling of e-wastes (end of life NdBFe permanent magnets, spent Lithium-ion batteries, Silicon PVs) via electrowinning
  - Electrochemical Iron & Steel Manufacturing
  - Electrochemical Sensors
- Advanced Multi-Functional Nanostructured Materials/High Entropy Alloys making via Electrodeposition: Combinatorial Alloy Design

suhash@msme.iith.ac.in +91 (40) 2301 6552

MSME Faculty

Prof. Saswata Bhattacharya

- Phase transformations in alloys and oxides
- Phase-field modelling of microstructural evolution
- Discrete Dislocation Dynamics
- Materials Informatics – Inverse Modeling
- Development of Multiscale Modeling Techniques and Tools for ICME

saswata@msme.iith.ac.in

Dr. Atul S. Deshpande

- Nanoparticle synthesis and self-assembly, sol-gel processes, templating techniques
- Novel nanostructured materials for advanced applications, including catalysis, energy storage and superhydrophobic coatings
- High entropy oxides

atuldeshpande@msme.iith.ac.in +91 (40) 2301 6554

Prof. Ranjith Ramadurai

- Multiferroic oxide thin films for fundamental science and functional device applications
- High-k dielectric thin films for CMOS technology and memory device applications
- Surfaces and Interfaces of oxide heterostructures on silicon and single crystalline oxide substrates
- Influence of process conditions, strain engineering and interface engineering on domains and domain dynamics of multiferroic thin films utilising scanning probe microscope

ranjith@msme.iith.ac.in +91 (40) 2301 6553

Dr. Mudrika Khandelwal

- High-performance and functional green composites
- Liquid crystals and self-assembly
- Drug Delivery
- Anti-fouling and anti-microbial materials
- Depth filters
- Energy storage and conversion (actuators)
- Nanofibrous devices, functional textiles

mudrika@msme.iith.ac.in

Dr. Subhradeep Chatterjee

- Phase Transformations and Microstructure Development
- Laser and Electron Beam Processing
- Welding and Surface Treatment
- Modelling and Simulation (Phase Field/FEM/CVM)

subhradeep@msme.iith.ac.in +91 (40) 2301 6558

MSME Faculty

Dr. Sairam K. Malladi

- In situ characterisation and technique development using MEMS devices (lab on a chip)
- Applications of *in situ* and correlative characterisation techniques to understand transformations in materials, Electrochemistry and Corrosion

srkm@msme.iith.ac.in +91 (40) 2301 6560

Dr. Rajesh Korla

- Deformation at room temperature
- Creep and super-plasticity
- Micro mechanical deformation
- Molecular dynamic simulations
- Nano indentation

rajeshk@msme.iith.ac.in +91 (40) 2301 6559

Dr. Shourya Dutta Gupta

- Plasmonics and Nanophotonics
- Sensors, Lab-on-a-chip devices, Microfluidics
- Alternative materials for plasmonics
- 2D Materials based optoelectronics

shourya@msme.iith.ac.in +91 (40) 2301 6561

Dr. Mayur Vaidya

- Diffusion-Deformation correlations in materials
- Phase growth and interdiffusion kinetics in thermoelectric materials
- Diffusion in multicomponent alloys
- Processing, characterisation and stability of nanocrystalline alloys

vaidyam@msme.iith.ac.in +91 (40) 2301 6564

Dr. Chandrasekhar Murapaka

- Spintronic-based memory and logic devices
- Nanomagnetic materials, Domain wall dynamics in ferromagnetic networks
- Spin torque nano-oscillators for RF applications
- Spin-orbit torque-induced magnetisation switching and dynamics, Magnetic tunnel junctions
- Micro and Nanofabrication techniques

mchandrasekhar@msme.iith.ac.in +91 (40) 2301 6562

MSME Faculty

Dr. Ashok Kamaraj

- Process metallurgy
- Physical modeling of unit processes
- Iron and steelmaking
- Life cycle analysis of processes and products
- Development of alloy steels

ashokk@msme.iith.ac.in +91 (40) 2301 6566

Dr. Anuj Goyal

- Computational Material Science
- Multiscale modeling
- Electronic structure theory
- Defects thermodynamics, Point defects
- Dislocations and interfaces
- Metals and semiconductors (oxides, nitrides, chalcogenides, halides).

anujgoyal@msme.iith.ac.in +91 (40) 2301 6567

Dr. Hemam Rachna Devi

- Advancing Nanomaterials for Sustainable Energy Technologies
- Green Hydrogen Generation
- Catalysis (electrocatalysis, photocatalysis, photoelectrocatalysis & photothermal catalysis
- Photothermal Sensors

rachnahemam@msme.iith.ac.in

Dr. Deepu J. Babu

- Nanoporous materials
- CVD, Adsorption and Membrane-based gas separation applications
- Carbon nanomaterials, MOFs
- Graphene & Graphyne and other 2D materials
- Defect Engineering, Plasma functionalisation

deepu.babu@msme.iith.ac.in +91 8289995143

Dr. Suresh Kumar Garlapati

- Printed electronics (transistors and CMOS logics)
- Oxide Semiconductors
- Electrolytes
- Organic electronics (transistors and chemiresistors)
- Gas sensors
- Memristors

gsuresh@msme.iith.ac.in +91 9100930553

Dr. Suresh Perumal

- Thermoelectric Materials, Metrology and Devices
- Magnetic Refrigeration
- Energy Storage devices
- Powder Metallurgy

suresh@msme.iith.ac.in +917022565805

Proposed Ph.D. topics (MOE seats: not an exhaustive list)

- Welding and Additive Manufacturing
- Powder Metallurgy & Sintering Mechanisms, Metal Additive Manufacturing, Nanostructures, High Entropy Alloys, MAX Phases and MXene, Advanced ceramics & composites, High temperature materials, Biomaterials, Microstructure-Mechanical Properties of Steels, Surface modification by Electro-Spark Deposition, Wear & Tribology
- Nanostructured carbon materials for Li-ion batteries and supercapacitors; Synthesis of novel multicomponent oxide (high entropy oxide) and high entropy alloy nanoparticles; Biomimetic approaches for superhydrophobic surfaces and coatings
- Nanoplasmonics and nano photonics, Alternative nanofabrication techniques and chemical synthesis, Optical sensors and modulators, Nanophotonic opto-electronic devices
- Phase Transformations and Microstructure Development, Laser and Electron Beam Processing, Welding and Surface Treatment, Modelling and Simulation (Phase Field/FEM/CVM)
- Mechanical Behavior of Materials both at room temperature as well as at high temperature, creep and superplasticity, micro mechanical deformation, molecular dynamic simulations, nano indentation, light weight alloys.
- Semiconductor materials and devices, printed and flexible electronics, oxide semiconductors, electrolyte gating, organic electronics, gas sensors, and memristors

Proposed Ph.D. topics (MOE seats: not an exhaustive list)

- In situ Transmission Electron Microscopy, In situ characterization and technique development using MEMS devices (lab on chip), Phase transformations in materials, Electrochemsitry and Corrosion, Graphene based super capacitors, Materials for Energy Applications
- Spintronic based memory and logic devices, Nanomagnetic materials,Domain wall dynamics in ferromagnetic networks,Spin torque nano-oscillators for RF applications, Spin-orbit torque induced magnetization switching and dynamics,Magnetic tunnel junctions, Micro and Nanofabrication techniques
- Nanoporous materials, Adsorption, Membranes, Active separations, Defect engineering, Carbon nanomaterials, Metal-organic frameworks, Plasma functionalization, Phase inversion, Chemical vapor deposition, Nanofluidics.
- Process Modeling & Simulation; Extraction & Molten Metal Treatment; Continuous Casting, Inclusion Engineering & alloy steel development; Hot-slag engineering, Metal Recycling & Life Cycle Analysis of Metallurgical Processes
- Computational multiscale modeling of metals and alloys, First principles modeling of defects in semiconductors (oxides, nitrides, chalcogenides). Computational materials design for functional (microelectronics, quantum technologies) and structural (superalloys) applications
- Thermoelectric Materials and Devices, Magnetic Refrigeration, Thermoelectric Metrology, and Powder Metallurgy
- Synthesis and characterization of resilient catalysts, including electrocatalyst, photocatalysts and photoelectrocatalyts for hydrogen production via water splitting

Sponsored Project Ph.D. topics

- Quantitative assessment of grain size and temperature effects on diffusion in medium entropy alloy (one JRF position for 3 years)
  (PI: Dr. Mayur Vaidya, Co-PI (from IITH) : Prof. Saswata Bhattacharya, Funding agency: SERB)

- Electron beam powder-bed fusion of nickel-base superalloys (Two JRF positions for 5 years)
  (PI: Prof. G.D. Janaki Ram G.D., Funding agency: DRDO)

- Printed, wearable sensor array for non-invasive monitoring of diabetic complications and chronic kidney diseases (one JRF position for 3 years)
  (PI: Dr. Suresh Kumar Garlapati, Funding Agency: MoE-STARS)

- Ultrafast THz Super-Spintronics (one JRF position for 3 years)
  (PI: Dr. Chandrasekhar Murapaka, Funding Agency: MoE-STARS)

Note that several projects are running in the Department. If candidates are found suitable, they will be later notified about various open positions through funded projects.

Eligibility & Qualifications

Candidates interested in Institute scholarship (**MoE**) and **Candidates with external funding (DST-INSPIRE/ joint CSIR-UGC JRF QUALIFIED/ industry sponsorship/ external registrants from national research laboratories) with the required qualifications (mentioned below) are encouraged to apply.** Externally funded candidates (non-MoE) are encouraged to contact interested MSME faculty before the exam/ interview schedule. Also, a few seats are separately available under Direct-Ph.D. admission of CFI students (above 9 CGPA) in the MSME department. The details with criteria are mentioned in the IITH admission portal.

Candidate should have one of the following qualifications:

- M.Tech./M.E. or equivalent degree (with a minimum first-class) in Materials Science and Engineering, Metallurgical Engineering, Ceramics, Mechanical Engineering, Manufacturing/ Production Engineering, Nanoscience, Polymer, Biomaterial, Chemical Engineering and other relevant areas. **OR**

- Direct Ph.D. - B.Tech. / B.E. in the above disciplines with a CGPA of 8.0 (Gen) and 7.5 (for all others) and a valid GATE score. The GATE criterion is not mandatory for B.Tech. or B.S. students graduating from an IIT/ IISc-B/ NIT /IISER or any CFTI. **OR**

- M.Sc. or equivalent in Materials Science/ Physics/ Chemistry / Biology or equivalent degree with a valid GATE Score in a relevant area or joint CSIR-UGC JRF, DST-INSPIRE, qualified or equivalent exam. **OR**

- Candidates working in industry and R&D Labs with a first-class B.Tech./B.E. or equivalent Degree in a relevant discipline and two years of experience are eligible to apply as an external Ph.D. student. GATE is not mandatory for them. However, they must provide an NOC from their current employer as well as a DSIR certificate.

Please note: - mere fulfillment of the eligibility criteria does not guarantee shortlisting
- only candidates shortlisted for written test and/or interview would be intimated (by email)