

Professor Nobuhiro Tsuji is one of the 12 full professor in the Department of Materials Science and Engineering at Kyoto University, Japan.



He is an internationally known researcher in the areas of physical metallurgy of structural materials, especially on fabrication and mechanical behavior of bulk ultrafine grained or nanostructured materials. Professor Tsuji has published more than 250 journal papers in prestigious international journals including Science, Nature Scientific Reports, Acta Materialia and Scripta Materialia. He has led some big-sized research projects in Japan, such as "Bulk Nanostructured Metals" project supported by the Grant-in-Aid for Scientific Research on Priority Area through the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan. He has received more than 30 awards domestically and internationally, including the 2010 Sydney H. Melbourne Award from SAE International in 2010 and the 5th JSPS Awards (as the first metallurgist awarded this prize) from JSPS (Japan Society for Promotion of Science).

Prof Nobuhiro Tsuji can be contacted by email at [nobuhiro-tsuji@mtl.kyoto-u.ac.jp](mailto:nobuhiro-tsuji@mtl.kyoto-u.ac.jp).

Dr. Pinaki Prasad Bhattacharjee is an associate professor in the department of Materials Science and Metallurgical Engineering at IIT Hyderabad. His main area of interest is to understand the evolution of microstructure, crystallographic texture and mechanical properties during thermo-mechanical processing of advanced alloys including steels, light metals alloys and multicomponent high entropy alloys. He has published more than 50 papers in leading international journals in the above areas.



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## About IIT Hyderabad

IIT Hyderabad started functioning in August, 2008. Currently it has 1700 students in total and offers undergraduate programs in eight disciplines, M.Sc in Mathematics, Chemistry and Physics, M.Phil. In liberal arts, M.Des. In design, M.Tech in eight disciplines and PhD in 13 disciplines.

Even though IITH started functioning in 2009, as of today IITH has nearly 160 faculty members. IITH has developed state-of-the-art infrastructure for advanced research in several frontier areas of science and technology. The research at IITH has been funded by several government and private agencies.

IITH also has an unique fractal academic program where the students have much greater flexibility in pursuing their academic interest. IITH strives to offer an innovative environment where breakthrough ideas can nucleate and grow.

<http://www.iith.ac.in/>

For details please contact

Dr. Pinaki Prasad Bhattacharje

Coordinator - GIAN Course on Dislocation Theory for Mechanical Behavior of Metals

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GLOBAL INITIATIVE ON  
ACADEMIC NETWORK (GIAN)  
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5 Days Course on

## Dislocation Theory for Mechanical Behavior of Metals

12<sup>th</sup> December - 16<sup>th</sup> December, 2016



INDIAN INSTITUTE OF TECHNOLOGY HYDERABAD  
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## ➤ Overview

Development of metallic materials with superior mechanical properties are critical for technological advancements in a wide variety of fields, including but not limited to manufacturing, automobile, aerospace, defence and energy. The importance of these materials could be understood considering the simple examples of automobile or aerospace sectors, where ultrahigh strength alloys can reduce the weight considerably while retaining the required strength, thereby reducing the carbon emission significantly. Similarly, advanced alloys with superior strength and stability at higher operating temperatures can significantly increase the energy efficiency.

A key aspect for controlling and improving the mechanical behavior of materials is to understand in-depth, the behavior of dislocations which are responsible for slip, the fundamental process governing plastic deformation in materials. This short lecture starts from macroscopic mechanical behaviors of metals and then covers the fundamentals of dislocation theory, plastic deformation and strengthening mechanisms of metals.

This course will be planned and offered as per the established academic guidelines of IIT Hyderabad.

## ➤ Course Objectives

The primary objectives of the course are as follows:

- ❖ Exposing participants to the fundamentals of dislocation theory,
- ❖ Linking dislocation theory with the plastic deformation and strengthening mechanisms,
- ❖ Introduce the participants to the cutting edge developments in the area

## ➤ Course Details

### December 12

#### Lecture 1: Macroscopic understanding for deformation of metals

- ❖ Definition of stress and strain
- ❖ Macroscopic deformation behaviors of metallic materials based on tensile stress-strain curves.

#### Lecture 2: Dislocations: geometry and relationship with plastic deformation of crystals

- ❖ Concept of dislocation

- ❖ Geometry of dislocations in crystal
- ❖ Dislocation motion (slip) and macroscopic deformation of crystals.

### December 13

#### Lecture 3: Elastic fields around dislocations

- ❖ Elastic field around edge and screw dislocations is introduced.
- ❖ Elastic energy of dislocations is related to the tension force of dislocations.

#### Lecture 4: Interaction between dislocations

- ❖ General concepts of obstacles to dislocation motion.
- ❖ strengthening of crystals through inhibiting dislocation motion.

### December 14

#### Lecture 5: Obstacles to dislocation motion

- ❖ Interaction between external stress field and dislocation formulated by Peach-Koehler equation
- ❖ Dislocation-dislocation interactions
- ❖ Dislocation-surface interactions etc.

#### Lecture 6: Strengthening mechanisms 1

- ❖ Dislocation strengthening (work-hardening)
- ❖ Grain refinement strengthening: Bailey-Hirsch equation.
- ❖ Hall-Petch relationship.

### December 15

#### Lecture 7: Strengthening mechanisms 2

- ❖ Solution hardening
- ❖ Precipitation hardening
- ❖ Dispersion hardening

#### Lecture 8: Controlling microstructures for strengthening metals

- ❖ Ultrafine and nanocrystalline materials, Processing by severe plastic deformation
- ❖ unique mechanical properties of ultrafine and nanostructured materials

#### Laboratory visit

- ❖ Demonstration of experiments for determining mechanical properties

### December 16 Examination

## ➤ Evaluation and Grading

Examination will be conducted at the end of the course based on the understanding of the concepts by the participants. Based on the evaluations finally a letter grade will be awarded to the participant. A completion certificate shall also be issued.

### Course Material

A copy of the presentation slides will be provided as a part of the course material.

## ➤ Who Can Attend

- ❖ Student at all levels (BTech/MSc/MTech/PhD) from Mechanical Engineering/ Manufacturing Engineering/ Materials and Metallurgical Engineering/Materials Science/Ceramics/Physics
- ❖ Faculty/Scientists/engineers from Universities/industries/R&D laboratories

Important Dates	Last date for receiving applications	25 <sup>th</sup> November 2016
	Intimation to participants	30 <sup>th</sup> November 2016
	Course Dates	12 <sup>th</sup> -16 <sup>th</sup> December 2016

Registration Fee**	For participants from academic institutions :	Rs 5,000
	For participants from industry : <td>Rs 10,000</td>	Rs 10,000
	For students* <td>Rs 2,000</td>	Rs 2,000
	Foreign Delegates <td>USD 500</td>	USD 500
	(*ID proof to be submitted)	

\*\*The Registration Fee includes access to attend all the lectures/tutorials, and a hardbound copy of the course material.

An additional fees of Rs. 1000/- has to be paid for providing Mineral water bottle / Lunch / 2 Coffee/Tea with snacks on all 5 days.

All payments should be made in the form of Demand Draft in favor of to be paid in favor of **Registrar IIT Hyderabad.**

The DD together with registration form should be sent to

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