



# INTRODUCTION TO CRYSTAL ELASTICITY AND CRYSTAL PLASTICITY

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**PRE-REQUISITES :** There are no pre-requisites in educational qualification. The knowledge in the courses like Solid Mechanics and Engineering Materials are added advantage

**INTENDED AUDIENCE :** Bachelor/Master/PhD students having background in Mechanical/Materials/metallurgical/Chemical engineering/Physics

## COURSE OUTLINE :

This course is primarily designed based on students who are interested in physics based model in broad area of materials and manufacturing processes. The aim of this course is to bridges the gap between continuum mechanics and material science where the behavior is described at different length scales. The course emphasizes on basic understanding of the related topics by mathematical and physical problems involved in studying mechanical behavior of conventional metals and alloys. Students will be able to develop fundamental understanding on the response of common engineering materials to mechanical loading at different length scales through the lectures and will be reinforced through assignments. The course is highly enjoyable to the beginners as it will be presented in most simplified way.

## ABOUT INSTRUCTOR :

Prof. Swarup Bag's The broad area of instructor is teaching and research interest of materials and manufacturing processes through computational models using finite element method and experiments. The instructor completed his Ph.D on "Development of bi-directional heat transfer and fluid flow model for reliable design of GTA and laser welding processes" from Indian Institute of Technology Bombay. Later he has worked at the Center for Material Forming (CEMEF), MINES Paris Tech, France in Metallurgy, Structure and Rheology (MSR) group. Soon after post-doctoral research experience, he joined in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati as a faculty member. His primary area of research is fundamental process modeling of welding and joining technologies, optimization of manufacturing processes and recrystallization in metal forming processes. Dr. Bag has published about 56 journal papers, 45 Conference papers, and 18 book chapters related to welding and joining processes. He is the author of the book 'Computational models for GTA and laser welding processes' and recipient of 'Royal Arc Award 2009' from Indian Institute of Welding for the best PhD thesis in welding. The instructor is involved in teaching the subjects like 'Physics of Manufacturing Processes', 'Engineering Materials', 'Advanced Welding Processes', 'Mechanical Behavior of Materials', 'Solidification Processes' and 'Manufacturing Technology' at IIT Guwahati. The subjects broadly covers the fundamentals of manufacturing processes, mechanical metallurgy, theory of plasticity, heat transfer in manufacturing processes, crystallography, dislocation mechanism, phase transformation and solidification.

## COURSE PLAN :

- Week 1:** Structure and properties of materials
- Week 2:** Elasticity Isotropic elasticity of materials; Anisotropic elasticity
- Week 3:** Continuum Plasticity
- Week 4:** Continuum Plasticity
- Week 5:** Crystal plasticity
- Week 6:** Crystal plasticity
- Week 7:** Hardening mechanism in metals
- Week 8:** Multi-scale approach to materials modeling