



# ADVANCED MATERIALS AND PROCESSES

## PROF. JAYANTA DAS

Department of Metallurgical and Material Science  
IIT Kharagpur

**INTENDED AUDIENCE** : Metallurgical & Materials Engineering; Materials Science; Physics

**PRE-REQUISITES** : Physical Metallurgy, Mechanical Metallurgy, Phase transformation, Solidification Processing

## COURSE OUTLINE :

Introduction and classification of structural and functional materials; High Temperature Materials: Structure, Processing, mechanical behaviour and oxidation resistance of Stainless Steels, Ni- and Co- Based Superalloys, Aluminides and Silicides, Carbon-Carbon and Ceramic Composites; Shape-Memory Alloys: Mechanisms of One-way and Two-way Shape Memory Effect, Reverse Transformation, Thermoelasticity and Pseudoelasticity, Examples and Applications; Bulk Metallic Glass: Criteria for glass formation and stability, Examples and mechanical behaviour; Nano-materials: Classification, size effect on structural and functional properties, Processing and properties of nanocrystalline materials, thin films and multilayered coatings, single walled and multiwalled carbon nanotubes; Soft and hard magnetic materials for storage devices: Design and Processing; Piezoelectric Materials: Processing and Properties; Advanced Processes applied for Advanced Materials: Single Crystal Growth, Rapid Solidification, Inert Gas Condensation, Physical and Chemical Vapour Deposition of Thin Films

## ABOUT INSTRUCTOR :

Prof. Jayanta Das is working as a faculty member since 2010 at IIT Kharagpur. His research activities have mainly encompassed the areas of alloy design, processing of bulk metallic glasses and their composites by rapid solidification and mechanical alloying, high entropy alloys and synthesis of bulk nanostructured alloys by cryo-rolling, their characterization, structure-property correlations, micromechanics of deformation of these advanced metastable alloys. Dr. Das has to his credit more than 120 research publications in peer-reviewed journals of international repute, which were cited more than 4000 times and has contributed 3 book chapters. He was the recipient of DAAD Fellowship in 2002, and Marie Curie Fellowship in 2004. He has been awarded Institute Silver Medal and Greaves Foseco Cash Prize of IIT Kharagpur in 2003, Young Scientist Award of German Society of Materials Research in 2006, Deutsche Bank Junior Award in 2009 (IFW Dresden, Germany), and IEI Young Engineers Award of Institution of Engineers India in 2012.

## COURSE PLAN :

- Week 01** : Introduction to metastable and functional alloys
- Week 02** : Bulk Metallic glasses Part I: Fundamental concepts
- Week 03** : Bulk Metallic glasses Part II: Mechanical and Functional properties
- Week 04** : Shape memory alloys and Pseudoelasticity
- Week 05** : Shape memory alloys: Applications and case studies
- Week 06** : Introduction to high temperature materials
- Week 07** : Superalloys: Alloy design, Microstructure and Properties
- Week 08** : Nano-materials Part I
- Week 09** : Nano-materials Part II
- Week 10** : Soft and hard magnetic materials
- Week 11** : Non-equilibrium Processes, Single Crystal Growth, Rapid Solidification, Inert Gas Condensation
- Week 12** : Advanced Functional Alloys