THERMO-MECHANICAL AND THERMO-CHEMICAL PROCESSES

TYPE OF COURSE: Rerun | Elective | PG | UG
COURSE DURATION: 8 weeks (23 Aug’ 21 - 15 Oct’ 21)
EXAM DATE: 23 Oct 2021


PRE-REQUISITES: Mechanical Metallurgy, Physical Metallurgy, Basic Thermodynamics

INDUSTRIES APPLICABLE TO: SAIL, TATA steel, Essar Steel, BHEL, JSW steel, Hindalco, TataMotors, Larsen & Toubro

COURSE OUTLINE:
Microstructural features like grain size, phase fraction and size distribution can be tailored by understanding and optimizing thermo-mechanical and thermo-chemical processes i.e. coupling the heat treatment either by introduction of mechanical energy into solids or by altering the chemistry of solids. Accordingly, several Thermo-Mechanical and Thermo-Chemical processes/treatments have been developed by the researchers. This course is designed to provide the fundamental science behind these processes so that optimal utilization of these processes is possible. Course will cover the utilization of flow stress data from hot deformation experiments to develop constitutive equations and processing maps, the interrelationship between microstructure and deformation features with the thermo-mechanical deformation processes. Important thermo-chemical processes such as nitriding, carburizing, carbonitriding, nitrocarburizing and boriding will be covered.

ABOUT INSTRUCTOR:

Prof. Sai Ramudu Meka is working as a faculty in the Department of Metallurgical and Materials Engineering, IIT Roorkee. He obtained his bachelor of engineering degree in Metallurgy from NIT, Surathkal in the year 2002. Then he served as a Junior Manager for Jindal Vijayanagara Steels Ltd. (JVSL), Toranagallu, Bellary, Karnataka. In 2004 he left JVSL to pursue his master's studies in Metallurgy and Materials science at IIT Kanpur.

COURSE PLAN:

Week 1: Introduction, Hot deformation processes I & II, Flow curves as a function of strain rate and temperature, Stress, strain, strain rate sensitivity
Week 2: Microstructural evolution, Recovery, Recrystallization, Dynamic recrystallization, DDRX, CDRX, GDRX
Week 3: Texture, Deformation texture (BCC), Deformation texture (FCC), Recrystallization texture (BCC), Recrystallization texture (FCC)
Week 4: Constitutive analysis, Low strain rate, Medium strain rate, High strain rate case study
Week 5: Deformation maps, Processing maps, Different models, Interpretation, Processing maps micro structure correlation
Week 6: SPD based thermo-mechanical processes, Friction stir Processing, Equal Channel Angular Processing, High pressure torsion case study.
Week 7: Introduction to Thermo-chemical surface treatments, Thermodynamics of gas/solid interaction.
Week 8: Phase transformations and consequent surface property enhancement during nitriding of iron based alloys.