Under the aegis of GIAN Advanced Course on

Manufacturing and Processing of Advanced Metallic, Ceramic and Composite Materials

14th to 18th March, 2022

GLOBAL INITIATIVE OF ACADEMIC NETWORKS

सत्यमेव जयते

Sponsored by: MHRD, Govt. of India

Organized By

Department of Mechanical Engineering,
MNIT, Jaipur (Rajasthan)

Jawahar Lal Nehru Marg, Malaviya Nagar, Jaipur, Rajasthan -302017,
Website: www.mnit.ac.in

Overview

This course will provide a comprehensive overview of materials manufacturing processes from the vantage point of elevated-temperature interactions among materials that manifest themselves in a wide variety of physical phenomena, and material properties and performance. Robust manufacturing technology demands scientific understanding of the metallurgical and materials mechanisms and processes underlying such interactions. The first one-third of the course content will provide solid foundational knowledge about diverse liquid-state, solid-state and vapor-state manufacturing processes. The remainder of the course will comprehensively cover high-temperature interactions, interface formation, and application to metal-matrix and ceramic-matrix composites, melting technology, refractory design, melt oxidation, liquid metal corrosion, solidification, crystal purification, infiltration, soldering, brazing, coating, sintering, and emerging 3D printing and other advanced processes. Material interactions at high temperatures are sensitive to a myriad of material and test parameters such as contact time, temperature, alloying, roughness, composition, coatings, atmosphere and crystal orientation among others. Conversely, such interactions could be used as a sensitive probe to investigate the material properties and behavior at elevated temperatures.

The course will cover the thermodynamics and kinetics of physical and chemical interactions among materials at elevated temperatures including spreading and capillary flow, starting with the classical description of surface energies, contact angle, work of adhesion, and interface bonding in non-reactive systems and moving to the more complex reactive spreading controlled by real-time chemical interactions involving dissolution, oxidation, wetting, reaction, diffusion, segregation and thermal and mass transport processes that control flow, spreading and interface formation. Case studies on contact angle and interfaces in oxides, carbon, carbides, borides, nitrides, silicides, and glass will be presented. Theoretical principles, processing technology and selected applications of brazed or diffusion bonded advanced ceramic, metallic and composite joints will be discussed. The role of thermo-elastic incompatibility and residual stresses on joint integrity, reliability and functionality will be discussed with the aid of latest real-world examples of structural, functional, and thermal management applications. Advanced joining concepts and technology developed over the last decade at NASA to join new and emerging ceramics and composites to high-temperature alloys will be described. Stress mitigation strategies using compliant interlayers of graded expansion and modulus shall be highlighted. Active learning based on problem-solving approach shall be implemented to provide each participant with the knowledge and skills needed to identify problems and generate viable solutions to mitigate manufacturing and processing problems.

International Expert:

Prof. Rajiv Asthana

Dr. Rajiv Asthana is a professor in the Robert F. Cervenka School of Engineering at the University of Wisconsin-Stout, USA, where he has taught 14 different courses in a lecture and laboratory environment for the last 22 years, developed new courses and curricula, and developed and managed laboratories in metal casting, metallurgy, and ceramic processing and testing. His professional experience also includes eight years with NASA as a consultant, guest researcher, and, early in his career, as a post-doctoral research associate. Dr. Asthana's materials research has focused on joining of ceramics, CMCs and advanced alloys; solidification and interface strength in advanced aerospace composites; and high-temperature capillary and interfacial phenomena.

Dr. Asthana has authored or coauthored nearly 200 journal and conference publications, and book chapters in the above areas, and five books including *Materials Science in Manufacturing* (Elsevier), *Engineering Materials & Processes Desk Reference* (Elsevier), and *Solidification Processing of Reinforced Metals* (Trans Tech). He has been an Editor of *Springer Materials*; Editor of *Journal of Materials Engineering & Performance*; co-editor,(Book) *Ceramic Integration & Joining Technologies* (Wiley); co-editor, (Book) *Green and Sustainable Manufacturing of Advanced Materials* (Elsevier); and a guest editor of special issues of four materials science and engineering journals published by Elsevier and Springer. He has presented 80 guest lectures in Poland, Italy, Germany, India, USA, Canada, China, Japan, Czech Republic and UK, and served as a grant reviewer / panelist for U.S. National Science Foundation, U.S. Department of Energy, and the U.S. Army among others. He also serves on various professional society committees, journal editorial boards, and organizing and advisory boards of international conferences.

Dr. Asthana was the inaugural Fulton Holt by Endowed Chair at University of Wisconsin-Stout. He has been a visiting professor / visiting scholar at University to Wisconsin-Milwaukee (USA) and Foundry Research Institute (Poland) and, early in his career, he was a scientist with Advanced Materials & Processes Research Institute (AMPRI) of CSIR at Bhopal. He is an elected Fellow of American Society for Materials and a recipient of the Distinguished Engineering Educator Award of The Engineers' Council (USA), Albert Nelson Marquis. Lifetime Achievement Award, Dean's Outstanding Alumni Award from University of Wisconsin-Milwaukee, and a NASA award for technical innovation. He earned his B. Tech (Hons.) and M. Tech. degrees from IIT Kharagpur and his doctorate in materials engineering from University of Wisconsin-Milwaukee.

Course Coordinators:

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Associate Professor , MNIT Jaipur

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Ex-Professor, MNIT Jaipur

Prof. G.S. Dangayach
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Registration form

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