FRACTURE, FATIGUE AND FAILURE OF MATERIALS

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PRE-REQUISITES : Any introductory courses on (a) Materials Science and Engineering, (b) Mechanical behavior of materials.

INTENDED AUDIENCE : Final year UG and PG students and PhD research scholars from various disciplines like Materials and Metallurgical Engineering, Materials Science, Ceramic Engineering, Nanoscience and Nanotechnology.

INDUSTRY SUPPORT : Any companies/Industries related to materials for instance Tata Steel, Tata Metallics.

COURSE OUTLINE :

The course is designed to implement the theoretical knowledge about the mechanical behavior of material, particularly focusing on fracture mechanics and fatigue characteristics to understand, assess and overcome failure. Both the linear-elastic as well elastic-plastic fracture mechanisms will be discussed. This will be followed by discussing the characteristics and mechanisms of fatigue cracks initiation and propagation. Importance of microstructure and environment in controlling the performance of materials will also be highlighted. Next, concepts will be developed on failure and methods for root cause analysis. The course will be equipped with necessary and appropriate schematic representation and case-histories in association with the required lectures on fundamental concepts. Participants will acquire a state of the art knowledge on the broad field of fracture and fatigue and their implementation in failure analysis of materials.

ABOUT INSTRUCTOR :

Prof. Indrani Sen is an Associate Professor at the Department of Metallurgical and Materials Engineering, IIT Kharagpur. She graduated (with a Doctoral degree) as an AICTE sponsored National Doctoral Fellow from the Department of Materials Engineering, Indian Institute of Science, Bangalore in 2010. Prior to that, she completed M.Tech. from IIT Kharagpur (2005) and received the Institute silver medal as the topper from the Materials Science Center. Following Ph.D., Dr. Sen pursued post-doctoral research at Chemnitz University of Technology, Germany and has bagged the prestigious Alexander von Humboldt (AvH) Fellowship. She also held visiting faculty and Av-Humboldt renewed research stay positions at University of Tennessee, USA (2016) and Ruhr University, Bochum, Germany (2018) and achieved Venus Internal Women Award-2018 for outstanding contribution in the field of Materials Engineering. Dr. Sen has made some notable contribution in the field of fracture, fatigue and failure of different category of conventionally produced, thermomechanical processed as well as state of the art additively manufactured materials which are promising candidates for aerospace, marine and biomedical applications. So far, she has managed to showcase her research globally through various National and International conferences as well as well reputed International Peer Reviewed Journal publications including Acta Materialia, Scripta Materialia, Materialia etc. and book chapter.

COURSE PLAN :

Week 1: Introduction to Fracture
Week 2: Linear Elastic Fracture Mechanics
Week 3: Fracture modes, Elastic – Plastic Fracture Mechanics
Week 4: Elastic – Plastic Fracture Mechanics, Impact Toughness
Week 5: Impact Toughness, Toughening of Materials, Environment Assisted Cracking
Week 6: Concepts of Fatigue, Un-Notched Fatigue – Fatigue crack Initiation
Week 7: Un-Notched Fatigue – High Cycle Fatigue
Week 8: Un-Notched Fatigue – Low Cycle Fatigue, Notched Fatigue – Fatigue crack propagation
Week 9: Notched Fatigue – Fatigue crack propagation, Role of microstructure, overloading on fatigue, Corrosion Fatigue
Week 10: Concepts of failure analysis
Week 11: Case studies related to failure due to Impact Fracture
Week 12: Case studies related to failure due to Fracture and Fatigue, Case studies related to failure due to Corrosion Fracture and Fatigue