

Course Overview

Fracture mechanics principles are widely used to mitigate the risk of failure in critical structures where the consequences of failure are costly or lead to unsafe conditions. In practice, this may involve predicting the number of duty cycles to grow a crack from some small, but inspectable size to failure. In other situations, it may involve designing to a thermal shock, or leak before burst criterion. To make an engineering assessment, one must typically: (1) understand the relevant failure modes and mechanisms; (2) obtain the material properties for the material and environment of interest relevant to the failure mode being analyzed; and (3) prepare the data for use in a design equation or analytical tool of choice, and (4) validate the tool of choice for the type of application.

This course provides an overview of several failure scenarios and mechanisms common to a range of engineering applications including both metals and non-metals, and discusses engineering methods to address them, including experimental methods and design tools, including potential pitfalls and common errors. While introductory training will be given on selected tools, course emphasis will be on providing understanding of the underlying principles well enough to guide test method and tool selection and/or development.

Internationally acclaimed academics, researchers and practitioners with proven knowledge, experience, and demonstrable ability in teaching, consultancy, research, and training in the field of Engineering Fracture Mechanics will deliver lectures and discuss cases in the course.

Important Dates

Last date for Registration: 15/05/2016.

Course Dates: 16/05/2016 to 21/05/2016

Course Registration Fee

Students (B.Tech/M.Tech/PhD): Rs. 1000/-

Faculty Members of Academic Institutions: Rs. 10000/
(TEQIP-II approved Institutions: Rs. 2000/- To be refunded after completion of course)

Industry/ Research Organizations: All modules: Rs. 20000/-
Any single module: Rs. 10000/-

The above fee includes cost of instructional material and computer use for tutorials. The participants will be provided accommodation on payment basis within IIT Ropar campus or nearby hotels.

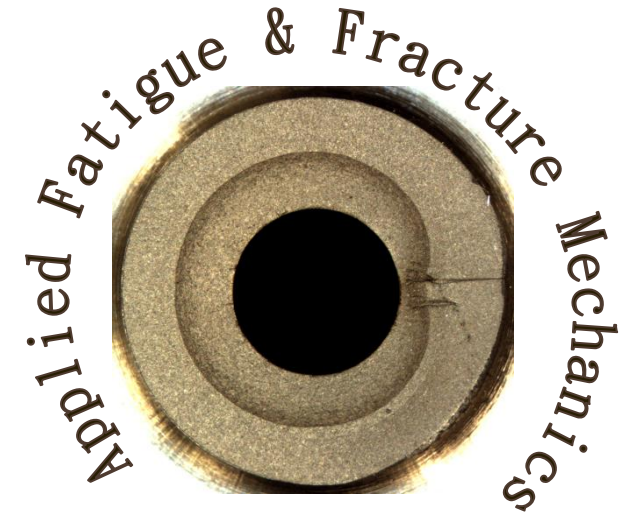
Course Registration Procedure

All prospective participants need to do web registration for the course on GIAN (<http://www.gian.iitkgp.ac.in/GREGN/index>) portal by making a onetime non-refundable payment of Rs. 500/-. After the mandatory web registration, only the shortlisted participants will be informed by email to register for the course by making full payment of the course registration fee either by NEFT (Account holder name: The Registrar, IIT Ropar; Account no: 30836125653; IFSC Code: SBIN0013181; Bank: SBI; Branch Name: IIT Ropar) or by sending a demand draft in favour of "Registrar, IIT Ropar" payable at Rupnagar-140001, Punjab before the last date of registration. Please send an email to course coordinator in case of any questions: dhiraj.mahajan@iitrpr.ac.in.

Objectives

The primary objectives of the course are as follows:

- i) Exposing participants to the fundamentals of fatigue and fracture mechanics practices.
- ii) Building in confidence and capability amongst the participants in the application of fatigue and fracture mechanics test methods and tools to mitigate risk of structural failure.



A Six Day Extensive Course

On

Applied Fatigue & Fracture Mechanics

At

IIT Ropar, Rupnagar, Punjab-140001

From

16th May '16 (Monday) to 21st May '16 (Saturday)

Teaching Faculty:

Dr. Richard Pettit

Founder & President, FractureLab, LLC., USA

Course Coordinator:

Dr. Dhiraj K. Mahajan

Assistant Professor, Department of Mechanical Engineering, IIT Ropar

Sponsored by:

Global Initiative on Academic Network (GIAN)

MHRD, Govt. of India

Course details

Time period: 16th May 2016 to 21st May 2016

Module	Day	Topic	Hours	Anticipated Subject Matter
A: Fundamentals of Fatigue & Fracture Mechanics	M	Why Fracture Mechanics?	15:15-16:15	Motivation, failure scenarios and risk mitigation, course overview
	M	Fundamental Principles	16:30-17:30	Inglis, Griffith, small-scale yielding
	Tu	Stress Analysis at the Crack Tip--Elastic	8:15-9:15	Theoretical stress magnitude and distribution, the Stress Intensity Factor (SIF), instability (Westergaard, Williams)
	Tu	Stress Analysis at the Crack Tip--Plastic	9:30-10:30	Irwin, Dugdale, process zone size, J-integral, HRR
	Tu	Mixed-Mode Fracture	10:45-11:45	Mode I growth, modal transition, effect of T-stress
	Tu	Lab 1: Franc2D Training	14:00-16:00	Hands on usage of CASCA/Franc2D
	W	Numerical Methods, Franc3D	8:15-9:15	Numerical SIF calculation
	W	Fatigue Crack Growth Analysis	9:30-10:30	Paris "law", NASGRO, spectrum loading, FASTRAN
	W	Fatigue Crack Growth Model Development & Validation	10:45-11:45	Perturbed Nasgro model, test matrix development, testing, validation

B. Advanced Topics in Fatigue & Fracture Mechanics		W	Lab 2: Crack Growth Testing	14:00-16:00	Regions 1-3, static & cyclic
		Th	Case Studies in Fracture 1	8:15-9:15	Found in nature, large and small
		Th	Case Studies in Fracture 2	9:30-10:30	Environmental effects, high-cycle fatigue
		Th	Case Studies in Fracture 3	10:45-11:45	Residual Stress effects
		Th	Lab 3: Problem solving section with examples	14:00-16:00	Hands on usage of FASTRAN
		F	Special Topics 1	8:15-9:15	Thermomechanical fatigue crack growth
		F	Special Topics 2	9:30-10:30	Anisotropic fracture phenomena
		F	Special Topics 3	10:45-11:45	Advanced test methods
		S	Examination for interested participants	9:00-11:00	

About Dr. Richard Pettit:



Dr. Richard Pettit is the founder and President of FractureLab, LLC. A graduate of Brigham Young University and Cornell University, Dr. Pettit has 30 years' experience in academia and industry in the field of structural integrity and fracture mechanics, including McDonnell Douglas, Boeing, NASA, the [Cornell Fracture Group](#), and Pratt & Whitney, where he served as a fracture mechanics specialist within the Core Structures Organization. While at Pratt, Dr. Pettit managed the company internal fracture codes, taught fracture mechanics courses in the Engineering Technical University, and served on a FAA sponsored

industry committee to provide technical input for development of the [DARWIN](#) code, including high temperature code functions such as Thermal Mechanical Fatigue Crack Growth. He also headed the Pratt portion of a USAF sponsored contract to assist the developers of [FRANC3D](#) with fracture simulation algorithms for non-planar crack growth including the effects of anisotropy and non-proportional loading. An [author](#) of several technical papers and Journal article reviewer for *Engineering Fracture Mechanics* and *International Gas Turbine Institute (IGTI) of ASME*, Dr. Pettit was a founding steering committee member of the [Integrative Material and Design Center](#) consortium at Worcester Polytechnic Institute, and is a principle affiliate of +4Pi, LLC, a Connecticut consulting firm. Perhaps more importantly, he has spent thousands of hours on the ground solving, and helping others solve, real-world problems in fracture mechanics.

About Dr. Dhiraj K. Mahajan:



Dr. Dhiraj K. Mahajan expertise is on experimental & computational investigations of fracture & fatigue behavior of various materials under aggressive environment. He has worked as a post doctoral researcher at the Interdisciplinary Centre for Advanced Materials Simulations (ICAMS), Ruhr University Bochum, Germany under the guidance of Prof. Alexander Hartmaier. from January 2010-December 2013. Earlier he obtained his PhD from IIT Kanpur on multi-scale modeling of the deformation behavior of glassy polymers under guidance of Prof. Sumit Basu. At IIT Ropar, Dr. Mahajan is responsible for establishing a state-of-the-art research facility dealing with fundamental research on materials under aggressive environment.