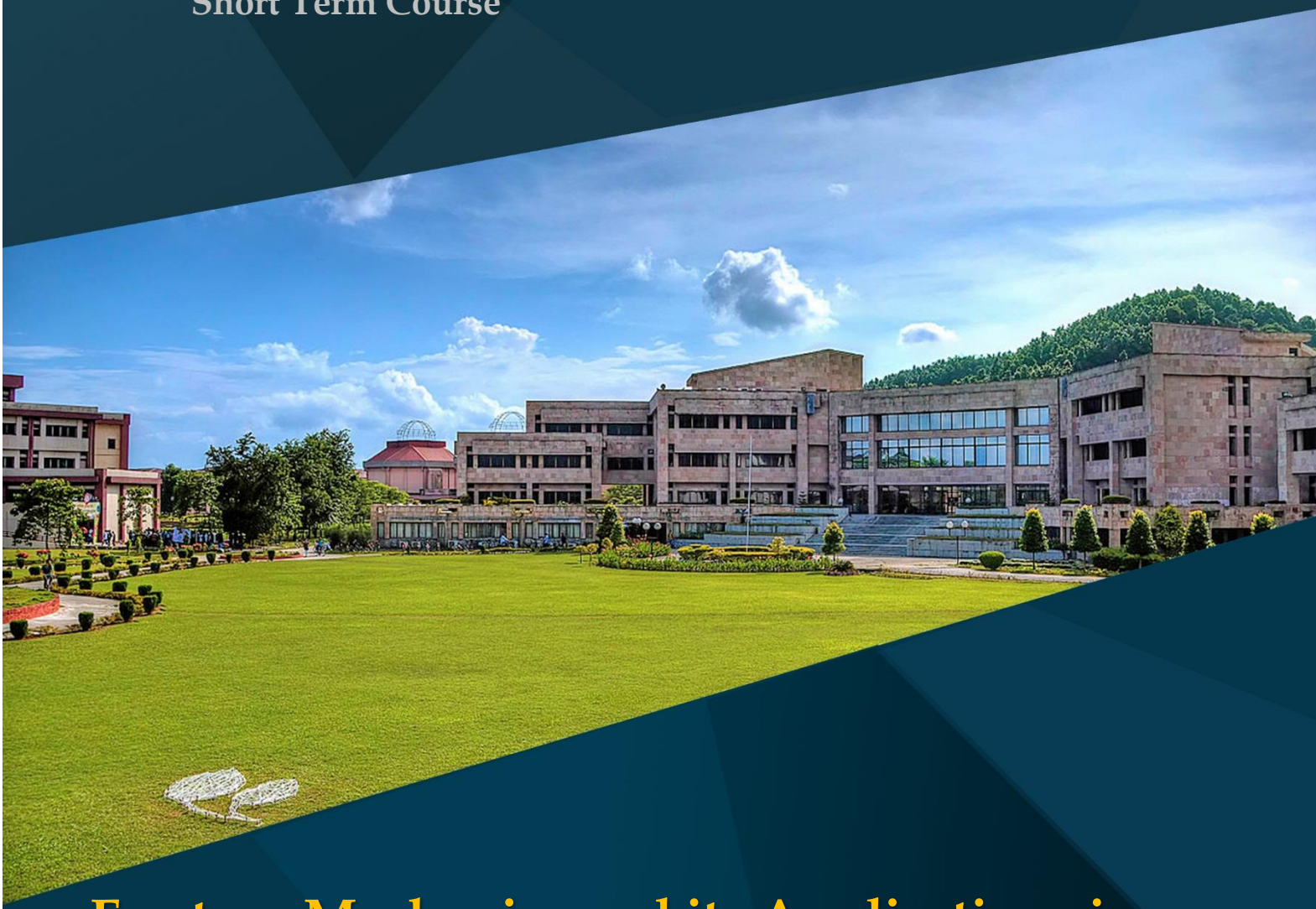
भारतीय प्रौद्योगिकी संस्थान गुवाहाटी
Indian Institute of Technology Guwahati

Short Term Course



Fracture Mechanics and its Applications in Laminated Composites

March 01st – March 5th, 2021

In ONLINE Mode

Conducted by:
Department of Mechanical Engineering

Organized by :
Knowledge Incubation for TEQIP
Centre for Educational Technology
URL: http://www.iitg.ac.in/cet

ABOUT THE COURSE

Fracture mechanics principles are widely used to mitigate the risk of failure in critical structures under the service loading conditions where the consequences of failure are costly or lead to unsafe conditions. 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 (3) prepare the data for use in a design equation or analytical tool of choice. A basic course on the linear elastic fracture mechanics (LEFM) will bring out the principles in elusive manner to address the mechanics of failure in such materials. The present short-term course will clearly address the need for the fracture mechanics in design and development of structures made of brittle materials or small-scale plasticity exhibit materials. The participants will also gain an understanding of the deformation and failure behaviour of composite materials and structures coupled with fracture mechanics principles. A laboratory class will introduce the computational modelling of composite material for fail safe design.

Faculty members of IIT Guwahati and eminent Professors from other organizations will deliver the lectures.

About the eminent Professor

Surjya Kumar Maiti is a Emeritus Professor in the Department of Mechanical Engineering, Indian Institute of Technology, Bombay. He has more than thirty-five years of teaching and research experience and has published nearly 100 papers in national and international journals. He received his PhD from the Indian Institute of Technology, Bombay, and worked as postdoctoral assistant at the University of Cambridge for two years (1981–1983). He has authored a book on 'Fracture Mechanics: Fundamentals and Applications', Cambridge University Press 2015.

COURSE OBJECTIVE

This course introduces the fundamentals of fracture mechanics and its application in composite materials from the point of view of Aerospace engineering design, manufacturing, and repair. Firstly, the principles of fracture mechanics based on linear elasticity is outlined. Some important terms are introduced to characterize the crack and its propagation under varieties of loading conditions. Finally, the LEFM principles are used to understand the failure behavior arising due to delamination in composite materials. In the passing, the mechanics of the laminated composites portion are discussed and some popular phenomenological failure theories are presented and contrasted against failure due to fracture mechanics. This will enable to tailoring specific properties and designing innovative laminate structures. To this end, the course will focus on the,

- An in-depth understanding of the linear elastic fracture mechanics concepts.
- Estimating the crack related parameters (SIF, J) using FEM
- Manufacturing composite laminates with edge crack for estimating the failure behavior
- Modelling of layered composite beam and plate structures.
- Developing a finite element modelling simulation of composite materials wih crack in commercial software

PROGRAMME SCHEDULE	
Time	**Topic**
Day 1	
09:00AM – 09:30 AM	Inauguration
09:30AM – 11:00 AM	Introduction to Fracture Mechanics
11:00AM – 11:30 AM	Break
11:30AM – 01:00 PM	Material Classification
01:00 PM – 02:00 PM	Lunch Break
02:00 PM – 03:30 PM	Concept of SIF, J-Integral, Energy Release Rate
03:30 PM – 04:00 PM	Break
04:00PM – 05:30 PM	Stress and Displacement field solution (Westergaard)
Day 2	
09:30AM – 11:00 AM	Continuum Mechanics – Strain Displacement, Non-linearity
11:00AM – 11:30 AM	Break
11:30AM – 01:00 PM	Introduction to Composite materials
01:00PM – 02:00 PM	Lunch Break
02:00PM – 03:30 PM	Composite Failure Analysis
03:30PM – 04:00 PM	Break
04:00PM – 05:30 PM	Stress and Displacement field solution (William's Expansion)
Day 3	
09:30AM – 11:00 AM	3D printing – properties and fracture
11:00AM – 11:30 AM	Tea Break
11:30AM – 01:00 PM	Plate Theory
01:00PM – 02:00 PM	Lunch Break
02:00PM – 03:30 PM	Crack Propagation Criteria
03:30PM – 04:00 PM	Break
04:00PM – 05:30 PM	FE for fracture, ABAQUS FE exercise

Day 4	
09:30AM – 11:00 AM	Load-deformation relation for Laminates
11:00 AM –11:30 AM	Break
11:30AM – 01:00 PM	ASTM based fracture testing (K_{IC})
01:00PM – 02:00 PM	Lunch Break
02:00PM – 03:30 PM	Pedagogy
03:30PM – 04:00 PM	Break
04:00PM – 05:30 PM	FE module in ABAQUS for composite damage
Day 5	
09:30AM – 11:00 AM	Composite Manufacturing Process and Micromechanics
11:00AM – 11:30 AM	Break
11:30AM – 01:00 PM	Composite Manufacturing Process (VARTM)
01:00 PM – 02:00 PM	Lunch Break
02:00 PM – 03:30 PM	Application of Composites in Biomedical
03:30 PM – 04:00 PM	Break
04:00 PM – 05:00 PM	Valedictory function

ELIGIBILITY

The course is open to faculty members/students from **TEQIP mapped Institutions/Engineering Colleges/ATUs**. No course fee is charged.

IMPORTANT DATES

The last date for the receipt of duly sponsored application:
By email: scanned copy: 21/02/21 (Saturday)
Intimation of selection: 25/02/21 (Thursday)

SELECTION CRITERIA

Number of seats: 50
Selection will be based on **First cum first served basis**. Participants from TEQIP-III mapped institutes will get preference.

ADDRESS FOR CORRESPONDENCE

Dr. Nelson Muthu
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Guwahati- 781039
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http://www.iitg.ac.in/nelsonm/

ABOUT TEQIP

TEQIP conceived in pursuance of the NPE-1986 (revised in 1992) by Govt of India as a long term program to be implemented in different phases. After successful execution of TEQIP II, TEQIP III starts from 2017-18 as Central Sector Scheme with a focus on the Low Income States, Northeast, Hill States and Islands. The third phase of TEQIP is also special in a way that it incorporates twinning arrangements between mentee & mentor institutions with an emphasis on Focused Training (PT) and Focused Interventions from IITs in terms of deliverables and accountability. KIT, established at IIT Guwahati under 2nd phase of TEQIP is a focal point for training Faculty, Staff and students from TEQIP-III institutions in Knowledge Engineering, Content Creation, Improving Teaching, Pedagogy & administrative skills in identified niche areas/disciplines.

ABOUT KIT

KIT (**K**nowledge **I**ncubation Cell for **T**EQIP) at IIT Guwahati functions as a multi-disciplinary as well as interdisciplinary Innovation Incubation Centre with a focus to impart Knowledge, infusing innovation and leading a path to achieve academic excellence. Its activities are in the area of improving quality of technical education, incubator of Innovative Ideas; implementer of contemporary pedagogy practices and development of Learning Content in Technical institutions while mentoring them.

ABOUT IIT GUWAHATI

SNAP OF CAMPUS

IIT Guwahati campus is spread over a sprawling 785 hectares plot of green land on the north bank of the river Brahmaputra around 25 km from the heart of the city. With hills and vast open spaces, the campus provides an ideal setting for training. Details on how to reach IITG Campus are available on the institute website

Website: www.iitg.ac.in

Application Form

1. Name (block letters):

2. Sex: ☐ Male ☐ Female

3. Category: ☐ General ☐ Reserved

4. Highest Academic Qualification:

5. Specialization:

6. Designation & pay scale:

7. Name of the organization:

8. Experience:

   (a) Teaching: (b) Industrial:

9. Address for communication:

   Pin code: Mobile No.:

   E-mail:

10. Choice of Accommodation: ☐ Guest House

    ☐ Hostel ☐ Will make my own arrangement.

Please register me for the course on **"Fracture Mechanics and its Applications in Laminated Composites"** to be held at IIT Guwahati. I am sending an advance copy of this application by email to the coordinator of the course.

I undertake to send the Hard copy signed by the Head of my Institution along with the draft of refundable fee.

Place:

Date: *Signature of the applicant*

SPONSORSHIP / NOMINATION CERTIFICTE

Prof/Dr./Mr./Ms./Mrs./.....

.....

is an employee of our institute and his/her application is hereby sponsored/nominated. The applicant is permitted to attend the short-term course **"Fracture Mechanics and its Applications in Laminated Composites"** at IIT Guwahati during 01/03/21 to 05/03/21 if selected.

I also certify that our institute/college is under the "Institution List" of 3rd phase of TEQIP Project of MHRD.

Date

Signature of Authority

Designation

Official Seal

Selected participants will be informed by e-mail. The duly sponsored/nominated application form should be mailed to:

Dr. Nelson Muthu

Department of Mechanical Engineering

Indian Institute of Technology, Guwahati
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