	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2018**
Department	**Mechanical Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
ME 415	**FRACTURE MECHANICS**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		
	To introduce different fracture mechanisms		CO1	Able to classify different types of fracture and understanding the behavior of engineering materials having microscopic flaws along with theory of elasticity (Understanding)
	To teach the elastic crack growth model under static load, fatigue crack growth model and also crack arrest methodologies		CO2	Able to solve fracture problems based on different fracture toughness calculation methods for different materials (Applying)
	To develop an ability to design a component including fracture mechanics approach		CO3	Able to analyze different fracture toughness test methods and crack detection methodologies (Analyzing)
			CO4	Able to evaluate the designed components and methodologies in fracture mechanics taking fracture toughness into account (Evaluate)
			CO5	Able to explain crack arrest methodologies, Non-destructive testing and evaluate the residual life from fatigue crack growth model (Evaluate)

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	2	0	0	0	0	0	0	0	0	0	0	0	3	0	0
2	CO2	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0
3	CO3	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0
4	CO4	0	0	3	0	0	0	0	0	0	0	0	0	3	1	0
5	CO5	0	0	3	0	0	0	0	0	0	0	0	0	3	1	0

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Brief introduction to elasticity, definition of failure, yield criteria, brief review of tensile, bending, torsion and fatigue test, origin of fracture mechanics, brief introduction to photoelasticity, testing process, ductile and brittle fracture, fracture in microscopic view point, examples using finite element method (FEM).	**05**	**CO1**
II	**Linear Elastic Fracture Mechanics (LEFM)** Elliptical hole in a plate, energy release rate (G), R-curve, interfacial fracture, Irwin's modification, pop-in phenomenon, Airy stress function, crack tip opening displacement, development of William's stress intensity factor (K), relation between K and G for crack initiation, evaluation of K for different geometries and embedded cracks, leak before break criterion, Dugdale's model, examples using FEM, fracture toughness testing procedure.	**20**	**CO2** **CO3** **CO4**
III	**Fatigue Crack Growth Model** Crack initiation, Paris law, sigmoidal curve, crack closure effect, plastic wake, empirical crack growth models, slip Bands, environment assisted cracking.	**06**	**CO5**
IV	**Crack Arrest and Repair** Strain energy density criterion, crack arrest principle, toughening methods, use of patches and hole, self healing polymers, metallic stitching, Non-destructive testing.	**05**	**CO5**
	Total Hours	**36**	

Essential Readings

1. P. Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill, First Edition, 2009.
2. T. Kundu, "Fundamentals of Fracture Mechanics", CRC Press, First Edition, 2008.

Supplementary Readings

1. T. L. Anderson, "Fracture Mechanics – Fundamentals and Applications", CRC Press, Fourth Edition, 2017.
2. D. Broek, "Elementary Engineering Fracture Mechanics", Kluwer Academic Publishers, Fourth Edition, 1982.