

BMEE322L	Engineering Failure Analysis	L	T	P	C
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Pre-requisite	BMEE202L, BMEE202P	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> 1. To familiarize the importance of failure analysis of mechanical components. 2. To provide insight on various material characterization tools. 3. To impart knowledge on design against failures and skills required for failure analysis. 					
Course Outcome:					
At the end of the course, the student will be able to					
<ol style="list-style-type: none"> 1. Differentiate types of failure of engineering materials and their characteristic features. 2. Apply various theories of failure to the components subjected to multidirectional loading. 3. Determine the life of a mechanical component subjected to variable loading. 4. Design for failure against corrosion, wear, creep and fracture. 5. Develop expertise on the experimental techniques and simulations used for failure analysis of various components and interpret the probable reasons for failure. 6. Apply concepts of statistics for failure analysis. 					
Module:1	Analysis of a Mechanical Failure	4 hours			
Preliminary Analysis, Microscopic Analysis-Fractography, Mechanisms of Damage and Failure, Case-studies involving failures.					
Module:2	Statistical Analysis of Failure	6 hours			
Industrial Engineering Tools, Basics of statistics, Normal, Weibull and log-normal distribution, Statistical modelling of failure					
Module:3	Mechanical aspects of Failure	7 hours			
Tensile Deformation of Ductile Metal, Combined stress, Principal stresses, Theories of failure, Tri-axial stresses and constraint, Plane stress, Plane strain, Stress concentration factors and notch sensitivity. Shock and impact loading.					
Module:4	Fatigue	7 hours			
Loading under high cycle fatigue conditions, Test methods, S-N curves, endurance diagrams, influence factors - Low cycle fatigue, fretting fatigue; Fatigue design for combined stress; cumulative damage and life prediction, statistical interpretation of fatigue test data.					
Module:5	Environmentally-Induced, Temperature Failures	7 hours			
Failures related to corrosion, hot corrosion and stress corrosion cracking; Damages due to hydrogen; Creep of materials, service failures during high temperature; Failures due to wear.					
Module:6	Fracture Mechanics	7 hours			
Fracture processes, Ductile and brittle fracture, Effect of strain rate and temperature. Fracture mechanics and Failures, Linear elastic fracture mechanics, fracture mechanics principles in design practice, Elastic Plastic Fracture Mechanics, Examples of crack-growth Analysis for cyclic loading.					
Module:7	Damage and Failure Mechanisms in Machinery	5 hours			
Modes of Failure in Shafts, Failures of Bearings, Failure of Transmission Elements: Gears and Coupling, Failure of Fasteners, Bolts, and Other Threaded Elements, Characteristic Failures in Turbo Machines					
Module:8	Contemporary issues:	2 hours			
		Total Lecture hours:		45 hours	
Text Book					
1	Jose Luis Otegui, Failure Analysis, Springer International Publishing, Switzerland, 2014				
Reference Books					
1.	Jones. D.R.H, , Failure Analysis Case Studies II,2001, ELSEVIER SCIENCE Ltd, UK				
2	Best Practice Guide on Statistical Analysis of Fatigue Data, Schneide C.R.A and				

	Maddox S J, 2015, TWI, Granta Park, Great Abington, Cambridge, UK		
3	George. E. Dieter, Mechanical Metallurgy, 2017, 3 rd Edition, McGrawHill,		
4	Anderson T.L. Fracture Mechanics, 2005, 3 rd Edition, CRC Press, Taylor & Francis Group,		
5	Suresh S, Fatigue of Materials, 1998(Print), 2 nd Edition, Cambridge University Press 2012(Online)		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT			
Recommended by Board of Studies		09-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022