

Branch Name:	Mechanical Engineering (Production Technology)
Program Code:	ET209
Course Name:	Reliability and Failure Analysis
Course Code:	2ET2090105T
Pre-requisite Course:	Zeal to learn the subject

Course Objectives:

1. This course provides the knowledge and practice regarding different Product Failure Theory, Reliability Prediction Models and Reliability evaluation.
2. This course gives hands on practice regarding Reliability of Engineering Design and Reliability Management.
3. This course gives knowledge of Diagnostic maintenance through ferrography, Vibration Signature, SOAP and other programme.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	3	1	-	4	24	60	16	40	-	-	-	-	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Introduction: Basic Probability-concept and various distributions, Concept of Reliability and analysis of various configurations of assemblies and sub-assemblies. Series, Parallel and other grouping. System reliability, Set theory, optimal Cut Set and Tie Set, 'stardelta' method, matrix method etc.	03	15
2	Product Failure Theory: System reliability determination through 'Event Tree' analysis and Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), Failure Modes, Effects and Criticality Analysis (FMECA). R.P.N, Graph theory, etc.	05	20
3	Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration-Application of Baye's theorem - cut and tie set method - Markov analysis. Optimal allocation of component reliability to achieve maximum system reliability - various techniques and methods such as Proportional, Conditional, Agree, Arinc, etc.	05	20

4	Reliability Evaluation: Concept of loading roughness, probability in design including evaluation of safety margin. Reliability of Engineering Design; Mean, Median & K statistics for Reliability evaluation (Non parametric, Short Sample).	05	20
5	Reliability Management: Reliability testing - Reliability growth monitoring - Non parametric methods - Reliability and life cycle costs - Reliability allocation - Replacement model.	05	20
6	Case Studies: Diagnostic maintenance through ferrography, Vibration Signature, SOAP and other programme. Case studies done in Indian perspectives using Short Sample, nonparametric reliability.	02	05

Review Presentation: The student is expected to spend minimum 2 hours per week (as mentioned in the teaching and evaluation scheme) to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. Student is supposed to explore various video lectures (e.g., NPTEL) available in the domain/subject. Student is required to make a review- presentation on the work carried out for the same. Recommended sites for journal papers are (1) asmedigitalcollection.asme.org (2) springer.com (3) sciencedirect.com (4) ieeexplore.ieee.org (5) scholar.google.co.in or others of similar repute.

List of Tutorials:

1. Life Distributions
2. Complex System Models & Reliability Block Diagrams
3. Design by Reliability & Probabilistic Approach
4. Relationship between reliability and Safety Factor
5. Failure Modes, Effect and Criticality Analysis [FMECA]
6. Fault Tree Analysis [FTA]
7. Reliability Estimation – Binomial Distribution
8. Reliability Estimation – Exponential Distribution
9. Reliability Estimation – Weibull Distribution
10. Management of Reliability Programs

List of Reference Books:

1. Gupta AK, “Reliability engineering and tero-technology”, Macmillan India Ltd, Delhi.
2. Srinath LS, “Reliability Engineering”, Affiliated East-West Press Pvt Ltd, Delhi.
3. O’Connor PDT, “Practical Reliability Engineering”, John Wiley & Sons Ltd, Singapore.
4. Modarres, "Reliability and Risk analysis ", Mara Dekker Inc., 1993.
5. John Davidson, “The Reliability of Mechanical system”, The Institution of Mechanical Engineers, London, 1988.
6. Smith C.O." Introduction to Reliability in Design”, McGraw Hill, London.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Explain terminology used for reliability engineering, risk and failure analysis.	2 Understanding
CLO2	To use statistical tools to characterize the reliability of an item and determine the reliability of a system in a manufacturing environment.	3 Applying 4 Analyze
CLO3	To apply concepts of FTA, RCM, & FMECA in managing the manufacturing organization with highest possible levels of reliability / availability.	3 Applying
CLO4	Critically evaluate failure modes and root causes.	4 Analyze 6 Creating
CLO5	Identify resources available to assist in failure analysis.	2 Understanding 4 Analyze
CLO6	Document and report on a failure, also to collect and analyze failure data.	4 Analyze 6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	H				M	H	H	H			M		M	
CLO2			M		H	L	M		M			L		M
CLO3		M		H		M		L		M			H	
CLO4		H		H					M	L		M		
CLO5	H				M			L		M	L		M	
CLO6		H		M	M	L		H	M		M			H

H: High, M: Medium, L: Low