SEMESTER S6

RELIABILITY ENGINEERING

Course Code	**PEIET632**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To enable students to understand important concepts of reliability engineering
2. To equip students to apply various tools, techniques and procedures of reliability engineering for practical scenarios.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Reliability concepts:** Definition of reliability, reliability vs. quality, reliability function, MTTF, hazard rate function, bathtub curve, derivation of the reliability function, failure and failure modes, causes of failures and unreliability. **Reliability models:** Constant failure rate model, time dependent failure models. Weibull distribution, normal distribution, lognormal distribution. Serial configuration, parallel configuration, combined series parallel systems, K-out-of-m systems.	**10**
2	**Redundancy techniques in system design:** Component vs unit redundancy, weakest-link technique, mixed redundancy, standby redundancy, redundancy optimization, double failures and redundancy, Markov analysis, load sharing systems, standby systems, degraded systems, three state devices, covariate models.	**8**
3	**Reliability in design:** Reliability in design process, system effectiveness, economic analysis and life cycle cost. Reliability allocation- optimal allocations, ARINC and AGREE methods. System safety and fault tree analysis- Tieset and Cut-set methods. Use of boolean algebra in reliability analysis.	**8**

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4	**Maintainability and availability:** Definitions and basic concepts, relationship between reliability, availability and maintainability, inherent availability, achieved availability, operational availability. **Economics of reliability:** Economic issues, manufacturers cost, customers cost, reliability achievement cost models, reliability utility cost models, depreciation cost models, availability cost model for parallel systems. Reliability management and reliability management by objectives.	**10**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

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End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic concepts of reliability, various models of reliability and failure concepts.	**K2**
CO2	Apply mathematical models of reliability and failure modes.	**K3**
CO3	Make use of the design process of reliability.	**K3**
CO4	Demonstrate the relation between reliability, availability, aintainability and economic aspects of reliability.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	1	1	-	-	-	-	-	-	2
CO2	3	3	-	3	3	-	-	-	-	-	-	2
CO3	3	2	3	1	1	-	-	-	-	-	-	2
CO4	3	2	2	1	1	-	-	-	-	-	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Reliability Engineering	Balagurusamy E.	Tata McGraw Hill	1st Edition, 2017
2	Reliability Engineering	Srinath L. S.	East West Press	4th Edition, 2005
3	Reliability and Maintainability Engineering	Charles E. Ebeling	Tata McGraw Hill	1st Edition, 201
4	Practical Reliability Engineering	Patrick D. T., O'Connor, Andre Kleyner	John Wiley & Sons Ltd	5th Edition, 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Reliability Engineering	E. E. Lewis	Wiley	2nd Edition, 1994
2	Quality Planning and Analysis	J.M. Juran, Frank M. Gryna	Tata McGraw Hill	5th Edition, 2007

Video Links (NPTEL, SWAYAM…)	
Link ID	https://archive.nptel.ac.in/courses/127/105/127105234/

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