GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS (29)
RELIABILITY ENGINEERING
SUBJECT CODE: 2742904
M.E. 4TH SEMESTER

Type of course: Major Elective (V)

Prerequisite: Basic Concept of Mathematics, Statistics and Probability.

Rationale: Increasing the ability of the components and the devices to sustain stresses, such that they operate for longer periods of time without failure is the goal of reliability engineering. This course will cover the basic concept of reliability, the specific design for reliability procedure of electronic systems and lifetime of Electronics Devices and capacitors used in electronic converters. This course will also encourage the student for the future research opportunities in the area of reliability of power electronics devices.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	**Introduction to Reliability** Basic concept, Meaning of reliability and its importance, Meaning of failure causes of failure, catastrophic failure and Degradation failure, failure rate curve, Useful life of components, Exponential case of chance of failures, failure data analysis and reliability measures. Probability theory, Random variables, Continuous and Discrete distributions, Stochastic Process, Markov chains.	**12**	**20**
2	**Different Failure Pattern** Statistical nature of failure - BT curve for electronics components,failure rate - MTTF – MTBF – MTTR,Hazard rate models, importance of mathematical models, Constant hazard rate model, linearly increasing hazard rate model, Weibull model, failure modes, common mode failure, system reliability analysis using reliability block diagram.	**10**	**20**
3	**Network Modelling and Reliability Analysis** Analysis of Series, Parallel, Series-Parallel network. K out of M system, Open and Short circuit failures, Reliability Analysis of Non Series Parallel Network, Path determination, different Methods like Boolean Algebra, Cut set, Tie set, Particular, Logical signal relations, Delta-Star and Baye's Theorem Method. Reliability Prediction and Allocation- Purpose, General Requirements, Prediction methodologies, Role and limitation of Prediction, Subsystem Reliability Improvement, Apportionment for new Unit, criticality.	**10**	**30**

4	**Maintainability, Availability and Reliability Testing** Introduction, Form of Maintenance, Maintainability and Availability Functions, Measure of Maintainability and Availability, Two unit parallel System with Repair, Preventive Maintenance, provisioning of spares, different kinds of testing, Component Reliability Measurement, Parametric methods, confidence Limits, Accelerated Testing, Equipment acceptance Testing, reliability growth testing	**10**	**20**
5	**Reliability of Electronics System** Importance, Various component used and their Failure mechanisms, Reliability Prediction of Electronic System, Part-count and Part-stress Method, PRISM method, Sneak Circuit Analysis, Failure Rate and Physics of Failure Mechanism of Electronic Components.	**06**	**10**

Reference Books:

1 Roy Billinton, Ronald N. Allan, "Reliability Evaluation of Engineering System: concept and techniques", Plenum Press, New York
2 K.K.Aggarwal, "Reliability Engineering", Kluwer Academic Publications, 1993.
3 E. Balaguruswamy, "Reliability Engineering", Tata McGraw Hill.
4 Boris Gnedenko,Igor Ushakov, "Probabilistic Reliability Engineering", John Wiley & Sons, Newyork, 1995.
5 Titu Marius I. Bajenescu Marius I. Bazu, "Component Reliability for Electronics System", Artech House USA, 2009

Cource Objectives:

After learning this course the students should be able to:

- To understand the fundamental concepts of Reliability and its importance.
- To study Reliability analysis of simple and complex network.
- To understand the Failure mechanism and Reliability Prediction of Electronic System.
- To motivate student for designing more reliable Power Electronics System.

List of Open Source Software/learning website:

- http://en.wikipedia.org/wiki/Reliability_engineering
- http://www1.iitb.ac.in/~re/
- http://nptel.ac.in

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.