GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (INDUSTRIAL ENGINEERING) (46)
RELIABILITY ENGINEERING AND TERO TECHNOLOGY
SUBJECT CODE: 2724608
SEMESTER: II

Type of course: Major elective II

Prerequisite: NA

Rationale: The aim of this course is to make students understand and appreciate the importance of reliability analysis. Students can get acquainted with different reliability calculation models. The course is also aimed at imparting knowledge of Total Productive Maintenance (TPM) to students.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Contents:

Sr. No.	Topic	Total Hours	% Weightage
1	**Reliability Concept:** Reliability function - failure rate - Mean time between failures (MTBF) - Mean time to failure (MTTF) - a priori and a posteriori concept - mortality curve - useful life availability - maintainability - system effectiveness.	05	12
2	**Reliability Data Analysis:** Time to failure distributions - Exponential, normal, Gamma, Weibull, ranking of data - probability plotting techniques - Hazard plotting.	05	12
3	**Reliability Mathematics:** Introduction to probability distributions, Concept of Bathtub Hazard Rate curve, Reliability evaluation of two-state device networks-series, parallel, k-out-of-m systems; Standby redundant systems, Reliability evaluation of three-state device networks-series and parallel.	05	10
4	**Reliability Determination Methods:** Network reduction technique, Path tracing technique, Decomposition technique, Delta-Star method. **Advanced Reliability Evaluation Concepts:** Supplementary variables technique, Interference theory, Human reliability, Common cause failures, Fault trees, Failure mode and effect analysis.	06	15
5	**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 - FTA - Limitations. **Reliability Management:** Reliability testing - Reliability growth	06	15

	monitoring - Non parametric methods - Reliability and life cycle costs - Reliability allocation - Replacement model.		
6	**Risk Assessment:** Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.	03	04
7	**Maintenances systems and economics of reliability:** Maintainability and availability concepts, MTBF, MTTR, MTBM & MDT repair hozard rate, maintainability and availability functions and their mathematical expressions.	05	10
8	**Maintenance and spares management:** Preventive replacement- individual breakdown replacement policy - individual preventive replacement policy - preventive group replacement. **Condition based maintenance** - advantages and disadvantages - vibration monitoring - vibration parameters - vibration instruments.	05	10
9	**Total Productivity Maintenance (TPM):** Distinctive features of TPM, Basic philosophy of zero defects (ZD), ZD and TPM, Maximizing equipment effectiveness, Six major losses, TPM development activities, Steps of TPM development, Autonomous maintenance, Planned maintenance, Measuring TPM effectiveness.	05	12

Reference Books:
1. Reliability Engineering, Srinath.L.S., Affiliated East West Press Pvt. Ltd., 2011
2. Reliability Engineering, Balagurusamy. E., Tata Mcgraw Hill Publishing Company, New Delhi,1984.
3. Reliability Engineering & Terotechnology, A K Gupta, Macmillian India Ltd.
4. Reliability and Risk analysis, Modarres, Mara Dekker Inc., 1993.
5. The Reliability of Mechanical system, John Davidson, published by the Institution of Mechanical Engineers, London, 1988.
6. Introduction to Reliability in Design, Smith C.O., McGraw Hill, London, 1976.
7. Reliability Anaysis and Prediction Engineering, K B Mishra, Elsevier Science Publishers,1992
8. Reliability Engineering in System Design and Operation, Balbir S. Dhillon. Von Nostrand Reinhold Company, New York, 1983.
9. Introduction to TPM, Nakajima Seiichi, Productivity Press India, Madras, 1997.
10. Introduction to Reliability Engineering, Lewis, E. E. John Wiley & Sons, New York, 1987.
11. Practical Reliability Engineering, O'Connor Patric D.T.3/e revised, John Wiley & Sons, 1995.

Course Outcome:

After learning the course the students should be able to…

1) Understand the concepts of reliability.
2) Understand and carry out reliability data analysis.
3) Understand reliability mathematics.
4) Get acquainted to various reliability prediction and evolution methods.
5) Know about maintenance systems and economics of reliability.
6) Understand maintenance and spare management.
7) Understand the concepts of Total Productive Maintenance.

List of Experiments:
1) Exercise on reliability concepts and calculations of MTBF and MTTF.
2) Exercise on reliability data analysis.
3) Exercise on reliability mathematics, bath-tub curve.
4) Exercise on reliability prediction model.
5) Exercise on risk assessment.
6) Exercise on maintainability and availability.

Open Ended Problems:

1) Students can have hands on practices on condition base maintenance (vibration instrument), if available, alternatively, evaluate the cases of condition base maintenance from research papers.
2) Students can evaluate the TPM implementation cases of different industries (available on net/research papers).

Major Equipments: Vibration measuring instrument (not mandatory)

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.