# GUJARAT TECHNOLOGICAL UNIVERSITY

**Master of Engineering**
**Subject Code: 3724608**
**Semester – II**
**Subject Name:** RELIABILITY ENGINEERING AND TERO TECHNOLOGY

**Type of course: Elective**

**Prerequisite: Nil**

## 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 |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | |
| L | T | P | C | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 30 | 20 | 150 |

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| 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. | 04 |
| 2 | Reliability Data Analysis: Time to failure distributions - Exponential, normal, Gamma, Weibull, ranking of data - probability plotting techniques - Hazard plotting. | 04 |
| 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. | 08 |
| 4 | Reliability Determination Methods: Network reduction technique, Path tracing technique, Decomposition technique, Delta-Star method.<br>Advanced Reliability Evaluation Concepts: Supplementary variables technique, Interference theory, Human reliability, Common cause failures, Fault trees, Failure mode and effect analysis. | 06 |
| 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.<br>Reliability Management: Reliability testing - Reliability growth monitoring - Non parametric methods - Reliability and life cycle costs - Reliability allocation - Replacement model. | 07 |
| 6 | Risk Assessment: Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment. | 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. | **04** |
| **8** | Maintenance and spares management: Preventive replacement- individual breakdown replacement policy - individual preventive replacement policy - preventive group replacement.<br>Condition based maintenance - advantages and disadvantages - vibration monitoring - vibration parameters - vibration instruments. | **04** |
| **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. | **04** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **15** | **25** | **25** | **15** | **10** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**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 Outcomes:**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Understand the concepts of reliability and carry out reliability data analysis. | 20 |
| CO-2 | Understand reliability mathematics and Get acquainted to various reliability prediction and evolution methods.. | 25 |
| CO-3 | Know about maintenance systems and economics of reliability | 15 |
| CO-4 | Understand maintenance and spare management | 20 |
| CO-5 | Understand the concepts of Total Productive Maintenance. | 20 |

**Term Work:**
The term work shall be based on the topics mentioned above.

**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.

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**Major Equipment:**

Vibration measuring instrument (not mandatory)

**List of Open Source Software/learning website:**

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).