



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3161913

Semester – VI

Subject Name: Industrial Safety and Maintenance Engineering

Type of course:

Prerequisite:

### Rationale:

This subject focuses on applying engineering concepts to the optimization of equipment, procedures, and departmental budgets to achieve better maintainability, reliability, and availability of equipment. Maintenance, and hence maintenance engineering, is increasing in importance due to rising amounts of equipment, systems, machineries and infrastructure. The subject also focuses on various safety engineering aspects like understanding hazards, quantifying risk, design for Safety, investigating accident, safety education and training.

### Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

### Content:

Sr. No.	Content	Total Hrs
1	<b>Quality, Reliability and Maintainability(QRM):</b> Productivity; Quality and Quality circle in Maintenance, engineering Reliability, Reliability Assurance through Redundancy, Maintainability and maintainability improvement, Maintainability vis a vis Reliability.	06
2	<b>Maintenance jobs and Technologies:</b> Wear and service life of equipment: Methods of assembly and fitting – assembly of keyed joints, splined joints, fixed joints, assembly of ball and roller bearings, repairs and assembly of gears. Wear of machines- types and reasons of wear, defects due to wear of equipment, corrosion and its prevention. Recovery and strengthening of machine elements various methods of recovery and increasing service life.	06
3	<b>Defect list Generation and Defect/Failure Analysis:</b> Defect Generation: types of failure, defect reporting and recording, defect analysis, failure analysis, equipment downtime analysis, breakdown analysis: FTA, FMTA, FMECA)	06
4	<b>Maintenance Types/Systems:</b> Planned and unplanned Maintenance, Breakdown Maintenance, corrective Maintenance, Opportunistic Maintenance, Routine Maintenance, Preventive Maintenance, Predictive Maintenance, Condition Base Maintenance System (CBMS): Online offline Monitoring, Visual and Temperature Monitoring, Leakage Monitoring, Vibration Monitoring: causes,	08



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	Identification and monitoring. Ferrography, Spectroscopy, Cracks Monitoring. Design Out maintenance, Selection of Maintenance Systems.	
5	<b>Maintenance Planning and Scheduling:</b> Factors involved in effective planning of maintenance work, Various methods of scheduling work, Categorization of plant/equipment for the purpose of priorities. Short term and Long Term Maintenance Plans: Major repair, Capital Repair and Annual Overhauls, Renovation, Revamping and Modernization.	06
6	<b>Safety Engineering:</b> Introduction, Hazard and Operability Study (HAZOP), Fundamental of Industrial Safety, Types and Categorization of Accidents. Accidents preventions, Safety Training. Onsite offsite Emergency Plans, Job Safety Analysis (JSA), Safety Survey, Reporting of accidents and dangerous occurrence.	08
7	<b>Safe Design and Operation of Plants:</b> Procedure for Ensuring Safety in Planning, Building and Operating Plants: Process Design, Planning, Construction and Commissioning of Plants, Alarm and Hazard Defense Plans, Information of the Public. Safety measures: Inherent Safety Measures, Passive Safety Measures, Active Safety Measures, Organizational Measures, Design of Safety Systems. Plant Layout and Spacing. Personal Safety and Personal Protective Equipment	05
	<b>Total Hours</b>	<b>45</b>

**Suggested Specification table with Marks (Theory): (For BE only)**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	20	20	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. Maintenance Engineering and management by R.C. Mishra & K. Pathak, PHI publication
2. Maintenance Engineering and management by K. VenkatRamana, PHI publication
3. Maintenance of Ind. Equipments-by Gellery & Pakelts, MIR publications
4. Ind. Maintenance by H.P. Garg, S. Chand & company
5. Modern Maintenance Management, by Miller & Blood
6. Industrial Safety and Maintenance by Deshmukh, Tata McGraw Hill
7. Industrial Safety Health Environment and Security By Basudev Panda, University Science Press
8. Process and Plant Safety, Hauptmanns, Ulrich, Springer Publication.



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**Course Outcomes:** Students will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Describe Quality, Reliability and Maintainability	10
CO-2	Understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.	15
CO-3	Demonstrate Defects and Failure analysis and different types of maintenance system	25
CO-4	Differentiate various Maintenance Planning and Scheduling techniques.	25
CO-5	Demonstrate safety practice aspects in industry.	25

### **Term Work:**

The term work shall be based on the topics mentioned above.

### **List of Experiments:**

1. Study about maintainability.
2. Study about wear and service life of equipment.
3. Study about maintenance and repair of production equipment.
4. Study about restoring of the guide ways of machine tools.
5. To study maintenance planning and scheduling.
6. Study about preventive maintenance.
7. Study about industrial safety.
8. Study about accidents and industrial hazards.
9. Study about safety measurement.
10. Study about legal aspect of safety and safety education.

### **Major Equipment:**

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

NPTEL notes and videos