GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171507
Semester – VII
Subject Name: Industrial Maintenance and Safety Engineering

Type of course: Professional Elective

Prerequisite: Nil

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	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**Quality, Reliability and Maintainability(QRM):** Productivity; Quality and Quality circle in Maintenance, engineering Reliability, Reliability Assurance through Redundancy, Maintainability and maintainability improvement, Maintainability vis Reliability.	04
2	**Maintenance Jobs and Technologies:** 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, wear reduction methods, lubricants-types and applications, Lubrication methods, corrosion and its prevention. Recovery and strengthening of machine elements various methods of recovery and increasing service life. **Fault tracing:** Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes	10

3	**Defect list Generation and Defect/Failure Analysis:** Defect Generation: types of failure, defect reporting and recording, defect analysis, failure analysis, equipment downtime analysis, breakdown analysis: FTA, FMTA, FMECA)	**05**
4	**Maintenance Types/Systems:** 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, Identification and monitoring. Ferrography, Spectroscopy, Cracks Monitoring. Design Out maintenance, Selection of Maintenance Systems. Short term and Long Term Maintenance Plans: Major repair, Capital Repair and Annual Overhauls, Renovation, Revamping and Modernization.	**10**
5	**Safety Engineering:** 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**
6	**Safe Design and Operation of Plants:** 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.	**08**
	Total Hour	**45**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**25**	**30**	**10**	**10**	**5**

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.
9. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services
10. Maintenance Engineering, H. P. Garg, S. Chand and Company
11. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication
12. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

Course Outcomes:

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.	25
CO-3	Demonstrate Defects/Fault and Failure analysis of different types of Machines/Equipments.	20
CO-4	Differentiate various Maintenance Planning and Scheduling techniques.	20
CO-5	Demonstrate safety practice aspects in industry	25

List of Experiments:

Experiments are as per above contents and should include case study and demonstration of below mentioned topics.

1. Case study and demonstration of equipment maintenance of Industry use
2. Case study and demonstration on machine tool maintenance
3. Case study on different maintenance system used in Industry
4. Shop/Industry visit and report preparation on maintenance activity
5. Presentation on safety rules, Preparation of different charts of safety for equipment/machine used in Organization /Industry.
6. Discussion and report on legal aspect of safety and safety education