GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3162509
Semester –VI
Production Engineering
Subject Name: Plant Maintenance and Safety Engineering

Type of course:

Prerequisite: Nil

Rationale:
The present course intends to give the exposure of various methods of plant maintenance and safety engineering which is an important manufacturing route to fabricate bulk storage and processing equipment's in industries for production engineering students. The subject focuses on knowledge and understanding of various layout techniques the underlying principles, Group Technology, flow design, material handling, plant maintenance and industrial safety.

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	**Defect/failure Analysis:** Defect generation, types of failures, defect reporting and recordings, defect analysis, failure analysis, Equipment downtime analysis (FTA, FMEA, FMECA).	02
2	**Maintenance Systems:** Planned and Un-Planned maintenance, Breakdown Maintenance, Corrective maintenance, Opportunistic Maintenance, Routine maintenance, Preventive maintenance, Predictive maintenance, Condition based maintenance, Design out maintenance, Selection of maintenance systems.	04
3	**Condition Monitoring:** Primary & Secondary Signals; On-line & Off-line Monitoring Visual & Temperature Monitoring ; Leakage Monitoring; Vibration- Characteristics, Analysis, Kurtosis and Spike Energy; Lubricant Monitoring-methods, equipment, Ferrography, Sepctroscopy; Cracks Monitoring; Thickness Monitoring; Corrosion Monitoring; Noise/Sound Monitoring, Smell/Odour Monitoring ; Thermography; Vibration Monitoring-causes, identification and measurement of machine vibration; Condition Monitoring of Lube and hydraulic Systems; Condition Monitoring of Cross Country Pipe Lines; Selection of Condition Monitoring Techniques. Benefits of Condition Monitoring.	06
4	**Maintenance Planning and Scheduling:** Job Planning; Job Manuals; Job Scheduling -Techniques, Charts & Networks; Job Scheduling within limited resources; Short-term plans; Long-term plans- Major Repair, Capital Repair and Annual Overhauls, Renovation, Revamping & Modernization; Five –	06

	Year rolling plans, Strategic, Corporate and turn-around planning.	
5	**Systematic Maintenance:** Codification & Cataloguing; Drawing Codification, History Cards; Instruction Manual and Operating Manual; Standard Operating Practice & Work Instructions; Maintenance Manual & Departmental Manual; Maintenance Time Standard; Maintenance-Operation Liaison; Maintenance Work Order & Work – Permit; Job Cards and Job Procedure; Job Monitoring, Feed Back & Control; Maintenance Records & Documentation; Systematised flow diagram of total maintenance.	04
6	**Computer Managed Maintenance System (CMMS):** Objectives; Approach towards Computerization; Selection & Scope of Computerization; Equipment Classification; Preventive Maintenance & Repair Planning Module- Jobs Catalogue, Codification of Breakdowns, Materials & Facilities; Job Sequencing and Preparation of Work order & Schedules; Materials Management Module-Cataloguing & Codification of Spares and Consumables, Spares Classification & Requirement Planning, Standardization & Rationalisation; Captive Engineering Shop Module-Work Centres, Process Planning, Route Card, Codification of Work Order & Route Card.	04
7	**Total Productive Maintenance (TPM):** Development & Scope of Concept; TPM vis-à-vis Terotechnology; Basic Systems of TPM; Procedure & Steps of TPM; Productivity Circles; TPM vis-à-vis TQQM; Benefits of TPM; Illustrative Job Lists.	03
8	**Other Concept of Maintenance Types/Systems:** 5-Zero Concept; Reliability based Maintenance (RBM), Role of Reliability Engineer and other groups, Evaluation of RBM programs; Creative Maintenance, Value Engineering in Maintenance; A fresh look into Maintenance.	03
9	**Safety Engineering:** Concepts and techniques, History of Safety movement –Evolution of modern safety concept- general concepts of management – planning for safety for optimization of productivity -productivity, quality and safety-line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.	05
10	**Safety Audit:** Introduction, Components of safety audit, types of audit, audit methodology, non conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.	04
11	**Safety performance Monitoring:** Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – problems	04
	Total Hours	45

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

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Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	25	20	15	15

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:

REFERENCES

1. Industrial Maintenance Management by Sushilkumar Srivastava, S Chand Publication
2. Accident Prevention Manual for Industrial Operations, N.S.C.Chicago, 1982.
3. Industrial Safety, Blake R.B., Prentice Hall, Inc., New Jersey, 1973.
4. Techniques of Safety Management, Dan Petersen, McGraw-Hill Company, Tokyo, 1981.
5. Industrial Accident Prevention, Heinrich H.W. McGraw-Hill Company, New York, 1980
6. Safety at Work, John Ridley, Butterworth and Co., London, 1983
7. Loss Prevention in Process Industries, Lees, F.P., Butterworth publications, London, 2 nd edition, 1990.
8. Relevant Indian Standards and Specifications, BIS, New Delhi.
9. Safety and Good House Keeping, N.P.C., New Delhi, 1985.

Course Outcomes: Students will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Demonstrate the maintenance and safety techniques for plants.	25
CO-2	Analyze health of plant's elements using condition monitoring techniques.	20
CO-3	Organize the maintenance schedule for plants.	20
CO-4	Perceive the safety audit and perform safety monitoring.	25
CO-5	Make use of concepts on total productive maintenance and reliability maintenance in plants.	10

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