

Course code	Course Name	L-T-P-Credits	Year of Introduction
ME376	Maintenance Engineering	3-0-0-3	2016
Prerequisite: Nil			
<p>Course Objectives:</p> <ul style="list-style-type: none"> • To enable the student to understand the principles, functions and practices of maintenance activities. • To develop ability in formulating suitable maintenance strategies to achieve reliable manufacturing system. • To introduce the different maintenance categories and failure analysis tools. • To equip with essential system diagnosis techniques so as to identify and take appropriate actions on error symptoms and causes of failures. • To illustrate the techniques used for maintenance management. • To empower with the skills to manage a manufacturing system to achieve continuous system availability for production. 			
<p>Syllabus:</p> <p>Maintenance – reliability – maintainability – availability – maintenance systems – condition monitoring – monitoring systems – failure analysis – maintenance effectiveness – quality assured maintenance – maintenance planning and scheduling – maintenance organization – maintenance costs – maintenance budgeting – human factor in maintenance – computer-aided maintenance management system – maintenance integration.</p>			
<p>Expected outcome:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> i. Understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment. ii. Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies. iii. Manage the manufacturing organization with highest possible availability. 			
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Gupta A. K., Reliability, Maintenance and Safety Engineering, University Science Press, New Delhi, 2009. 2. Rao S. S., Reliability-Based Design, McGraw-Hill, Inc, New York, 1992. 3. Srivastava S. K., Maintenance Engineering and Management, S. Chand & Company Ltd., New Delhi, 1998. 4. Venkataraman, Maintenance Engineering and Management, Prentic-Hall of India Pvt. Ltd., New Delhi, 2007. 			

Reference Books:

1. Davies, Handbook of Condition Monitoring, Chapman & Hall, 1996.
2. Garg M. R., Industrial Maintenance, S. Chand & Co., 1986.
3. Higgins L. R., Maintenance Engineering Hand book, McGraw Hill, 5th Edition, 1988.
4. Mishra R. C. and Pathak K., Maintenance Engineering and Management, PHI Learning Pvt. Ltd., New Delhi, 2009.

Course Plan

Module	Contents	Hours	End Sem. Exam. Marks
I	Maintenance – basic concepts, purpose, functions and objectives of maintenance.	1	15%
	Principles, benefits and effects of maintenance	1	
	Inter-relationship between productivity, quality, reliability and maintainability – maintenance productivity – quality in maintenance.	1	
	Reliability – basic concepts – bathtub curve – failure rate – mean time before failure.	1	
	System reliability – reliability of series and parallel systems.	1	
	Maintainability – mean time to failure – mean time to repair.	1	
	Availability – inherent, achieved and operational availability – reliability, availability and maintainability (RAM).	1	
II	Maintenance strategies / systems – types – basis for selection. Breakdown maintenance – corrective maintenance	1	15%
	Preventive maintenance – process flow – frequency in preventive maintenance.	1	
	Predictive maintenance – components – advantages and disadvantages.	1	
	Condition based maintenance and condition monitoring – monitoring systems.	1	
	Performance monitoring – visual, tactile and aural monitoring – leakage monitoring.	1	
	Temperature monitoring – thermography – advantages.	1	
	Thickness monitoring – acoustic monitoring – smell/odour monitoring.	1	
FIRST INTERNAL EXAMINATION			
III	Vibration monitoring – vibration fundamentals – vibration analysis.	1	15%
	Vibration transducers – types.	1	
	Machinery vibration trouble shooting – machinery vibration standard, severity chart and acceptable limits.	1	
	Lubricant monitoring – components and techniques – filter debris analysis & filtergrams.	1	
	Ferrography – spectroscopic oil analysis program.	1	

	Crack monitoring – techniques.	1	
	Corrosion monitoring – techniques.	1	
IV	Reliability centered maintenance (RCM) – steps – flow diagram – basic guidelines.	1	15%
	Defect and failure – definitions – basics of failures – failure generation – failure analysis.	1	
	Fault tree analysis (FTA)	1	
	Event tree analysis (ETA)	1	
	Root cause analysis (RCA)	1	
	Failure modes and effects analysis (FMEA)	1	
	Failure mode effect criticality analysis (FMECA)	1	
SECOND INTERNAL EXAMINATION			
V	Terotechnology – definitions – terotechnology system – terotechnology process – strategies.	1	20%
	Total productive maintenance (TPM) – features – methodology – basic systems of TPM – TPM and terotechnology.	1	
	Six sigma maintenance.	1	
	Lean maintenance – 5-zero maintenance concept – 5-S maintenance concept.	1	
	Business centered maintenance (BCM) – six pillars – success factors.	1	
	Maintenance effectiveness – overall equipment effectiveness – key performance indicators – maintenance performance measuring indices.	1	
	Quality assured maintenance – need – maintenance work quality – use of c-chart for quality control in maintenance.	1	
VI	Maintenance planning and scheduling.	1	20%
	Maintenance organization – objectives and characteristics – centralized and decentralized maintenance.	1	
	Maintenance costs – classification of maintenance costs – maintenance cost analysis – cost effectiveness analysis.	1	
	Maintenance budgeting – types of maintenance budget – preparation of maintenance budget.	1	
	Human factor in maintenance – manpower planning for maintenance – objectives and stages of manpower planning – training for maintenance personnel.	1	
	Computer-aided maintenance management system (CMMS) – functions, applications and advantages of CMMS.	1	
	Maintenance integration – various steps in integration – scheme of integration of maintenance function with other functions.	1	

Question Paper Pattern

Maximum marks: 100

Time: 3 hrs

The question paper should consist of three parts

Part A

There should be 2 questions each from module I and II

Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

There should be 2 questions each from module III and IV

Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

There should be 3 questions each from module V and VI

Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.

