

MME: Machine Condition Monitoring and Fault Diagnostic techniques

Programme: B. Tech. (ME).
Course: PE

Year: 4th
Credits: 3

Sem: 8th
Hours: 40 lec

Course Context and Overview (100 words):

The objective of the course is to provide basic knowledge of condition monitoring technologies used for rotating and reciprocating machines. It covers the fundamental principles of vibrations, maintenance techniques, analysis of wear debris, instruments and special monitoring methods. This will help the students to develop the skill in understanding different types of monitoring approaches used for condition monitoring of machines. At the end of the course, the student will be able to understand the principle and analysis procedure for performing condition monitoring.

Prerequisites Courses: Kinematics & Dynamics (MME206)

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: Understand effective maintenance schemes in industries
C02 : Diagnose the mechanical systems by applying vibration monitoring techniques
C03 : Apply oil analysis technique to diagnose the wear debris.
C04 : Identify nonconventional methods for machine diagnoses.
C05 : Develop modern technologies for effective plant maintenance.

Course Topics:

Topics	Lecture Hours
UNIT - I Introduction: Failures - System, component and services failures - classification and its causes, Maintenance Schemes - objectives - types and economic benefits, break down, preventive and predictive monitoring.	5
UNIT – II Vibration Monitoring - causes and effects of vibration, review of mechanical vibration concepts - free and forced vibrations, vibration monitoring examples, critical vibration levels. Vibration signature of active systems (Gears and Bearings) - measurement of amplitude, frequency and phase: Vibration characteristics of non-defective gears; Vibration characteristics of non-defective bearings; Vibration characteristics of defective gears; Vibration characteristics of defective bearings.	9

UNIT - III Vibration monitoring equipment- system monitors and vibration limit detectors, vibration sensors (contact and non-contact type) -factors affecting the choice of sensors, Instrumentation, data acquisition and display elements, vibration meter and analyzers, measurement of overall vibration levels. Signal analysis- signal filtering, signal analysis -online and offline techniques Sample rate and aliasing, time and frequency domain analysis. Sound Monitoring: Sound frequencies, sound loudness measurement, acoustic power, sound measurement, sound level meters, sound analyzers, sound signal data processing.	10
UNIT – IV Contaminant analysis: Contaminants in used lubricating oils - monitoring techniques (wear debris) -SOAP technique, Ferrography, X-ray spectrometry, Particle classification. Temperature Monitoring - Various techniques - thermograph, pyrometers.	6
UNIT – IV Non-destructive techniques: Ultrasonic measurement method, shock pulse measurement, Acoustic Emission mentoring, critical speed analysis, Cepstrum analysis, Modal testing, Machine Condition Indicators: RMS value, peak value and crest factor, kurtosis, defect severity index. Case Studies: Practical applications of diagnostic maintenance, condition monitoring of mechanical and electrical machines.	10

Textbook references (IEEE format):

Text Book:

1. Rao J. S., Vibration Condition Monitoring, Narosa Publishing House, 2/e 2000.
2. Allan Davis, Hand book of Condition Monitoring, Chapman and Hall, 2000.
3. Choudary K K., Instrumentation, Measurement and Analysis, Tata McGraw Hill, 2012
4. Mohanty A. R., “Machinery Condition Monitoring”, CRC Press.

Reference books:

1. Randall R. B., “Vibration Based Condition Monitoring” Wiley
2. Isermann R., Fault Diagnosis Application, Springer-Verlag Berlin, 2011.
3. Rao. R. B.K. N., “Handbook of Condition Monitoring” Elsevier Advanced Technology

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.): NPTEL.

Evaluation Methods:

Item	Weightage
Assignments	10
Midterm	30
Quiz	20
End-Term Examination	40

Attendance: 70% Compulsory to present in exam.

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