NIRMA UNIVERSITY

Institute:	**Institute of Technology, School of Engineering**
Name of Programme:	**B. Tech. in Electrical Engineering**
Semester:	**VII**
Course Code:	4EE103ME25
Course Title:	**Condition Monitoring of Electrical Machines**
Course Type:	**Department Elective-IV**
Year of Introduction:	**2025 – 26**

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. apply principles of time and frequency domain for condition monitoring of electrical machines (BL3)
2. distinguish the types of fault(s) in electrical machine (BL4)
3. choose an appropriate non-destructive diagnostic technique to diagnose the electrical machine (BL3)
4. infer the results of non-destructive tests and take necessary precautions (BL5)

Unit	Contents	Teaching hours (Total 45)
Unit-1	**Maintenance and Condition Monitoring** Importance and necessity of maintenance, Different maintenance strategies like Breakdown maintenance, planned maintenance, preventive maintenance and condition-based maintenance of transformer, induction motor and alternators, Insulation failure modes, Concept of condition monitoring of electrical equipment	04
Unit-2	**Various Test Techniques** Thermal test, acoustic test, vibration analysis, chemical analysis: dissolved gas analysis, Furan analysis, degree of polymerisation, electrical analysis: current signature analysis, insulation resistance test, loss angle test, partial discharge test, impulse test, frequency response analysis, wavelet transform, short time Fourier transform, power spectral density, International guidelines and standards for various test techniques	15
Unit-3	**Condition Monitoring of Transformer** Construction and operation of transformer, causes of failure in transformer, winding faults: winding to ground fault, failure across large portion of winding, inter winding breakdown, failure between small portion of winding, diagnostic test techniques for transformer, various case studies, application of AI and ML techniques in diagnosis	10

Unit-4	**Condition Monitoring of Rotating Electrical Machines** Construction, operation and failure modes of electrical machines, Structure of rotating electrical machines and their types, Machine specification and failure modes, Typical root causes and failure modes, induction motor faults, diagnostic techniques for rotating electrical machines, various case studies, application of AI and ML techniques in diagnosis	10
Unit-5	**Remaining Life Estimation** Introduction, life estimation based on thermal modelling: aging acceleration factor, hot-spot factor, Life estimation based on cellulose degradation kinetics: life estimation from DP value, Furan value, DGA results, probabilistic approach towards life estimation	06

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:
This shall consist of at least 08 laboratory experiments based on the syllabus.

Suggested Readings:

1. S. Chakravorti, D. Dey, B. Chatterjee, *Recent trends in the condition monitoring of transformers*, Springer.
2. H. Toliyat, S. Nandi, S. Choi, H. Meshgin-Kelk, *Electric machines: Modelling, condition monitoring and fault diagnosis*, CRC press.
3. G. Stone, E. Boulter, I.Culbert, H. Dhirani, *Electrical insulation for rotating machines*, IEEE Press.
4. W. Thomson, I. *Culbert, current signature analysis for condition monitoring of cage induction motors*, IEEE press – Wiley.
5. O. Wing, *Classical circuit theory*, Springer.
6. Recent literature in renowned journals, international standards and white papers.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1.	Identify the various mechanical faults in electrical machines.	02
2.	Simulation of the impulse wave generation.	02
3.	Frequency response analysis for the diagnosing the machine windings.	02
4.	Determination of transfer function and equivalent circuit from frequency response.	04
5.	Demonstration of travelling wave concept using co-axial cables.	02
6.	Implementation of statistical methods for the diagnosis of electrical machines.	02
7.	Implementation of wavelet transform for a non-stationary wave.	02
8.	Comparing fast Fourier transform with short time Fourier transform for non-stationary wave.	04 04