NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Electrical Engineering
Semester:	VII
Course Code:	2EEDE60
Course Title:	Condition Monitoring of Electrical Machines
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective**/ ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective/ ☐ Any other)
Year of Introduction:	2021 – 22

Credit Scheme

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

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to-
1. identify the need and importance of condition monitoring of electrical machine
2. identify the type of fault in electrical machine
3. select appropriate non-destructive diagnostic technique to diagnose the electrical machine
4. infer the results of non-destructive tests and take necessary precautions

Syllabus: **Total Teaching hours: 30**

Unit	Syllabus	Teaching hours
Unit-I	**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-II	**Various test techniques** Thermal test, acoustic test, vibration analysis, chemical analysis: dissolved gas analysis, Furan analysis, degree of polymerisation, electric analysis: current signature analysis, insulation resistance test, loss angle test, partial discharge test, impulse test, frequency response analysis.	10
Unit-III	**Condition monitoring of Transformer** Construction and operation of transformer, causes of failure in transformer, winding faults: winding to ground failure, failure across large portion of winding, inter winding breakdown, failure between small portion of winding, diagnostic test techniques for transformer, remaining life estimation, various case studies.	08
Unit-IV	**Condition Monitoring of Rotating Electrical Machines** Construction, operation and failure modes of electrical machines, structure of electrical machines and their types, machine specification and failure modes, failure sequence and effect on monitoring, typical root causes and failure modes, induction motor	08

faults, diagnostic techniques for rotating electrical machines, various case studies.

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 10 laboratory experiments / simulations based on the syllabus.

Suggested Readings/ References:
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,
4. IEEE Press
5. W. Thomson, I. Culbert, Current signature analysis for condition monitoring of cage induction motors, IEEE press – Wiley.
6. Recent literature in renowned journals, international standards and white papers.

Suggested List of Experiments:
1. To study and generation of impulse voltage using impulse generator.
2. To perform testing and offer diagnosis of transformer using frequency response analysis.
3. To simulate long transmission line network and understand travelling wave using Bewley's lattice diagram.
4. To perform diagnostic testing of induction machine using current signature analysis.
5. A case study on various mechanical faults in electrical machines.
6. A case study on diagnostic testing of induction machine using vibration analysis.
7. A case study / simulation approach to determine machine transfer function from frequency response.
8. A case study on statistical data usage / interpretation for diagnosis of electrical machines.
9. A case study on partial discharge test in electrical machines.
10. A case study based on chemical analysis test of transformer oil.

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. academic year 2021-22 and onwards