Program : **Diploma in Electrical and Electronics Engineering**	
Course Code : **4033**	Course Title: **Induction Machines**
Semester : **4**	Credits: **4**
Course Category: **Program Core**	
Periods per week: **4 (L: 3 T: 1 P: 0)**	Periods per semester: **60**

Course Objectives:

- To familiarise with the construction and working of transformers
- To comprehend the testing procedures of transformers
- To familiarise with the construction and working of three phase induction motor
- To know the testing procedures and identify the performance characteristics of three phase Induction Motors

Course Prerequisites:

Topic/Description	Course Code	Course Title	Semester
Basic Electrical Engineering		Fundamentals of Electric Circuits	3
DC Machines		DC Machines and Traction Motors	3

Course Outcomes

On completion of the course, the students will be able to:-

COn	Description	Duration (Hours)	Cognitive Level
CO1	Develop the equivalent circuit of a single phase transformer	14	Applying
CO2	Apply various tests to pre-determine and determine the performance of a transformer	15	Applying
CO3	Identify various torques and power stages in three phase induction motor	14	Applying
CO4	Construct circle diagram to pre-determine the performance of three phase induction motors and choose various methods for speed control	15	Applying

	Series Test	2	

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3						
CO2	3						
CO3	3						
CO4	3						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline

Module Outcome	Description	Duration (Hours)	Cognitive Level
CO1	**Develop the equivalent circuit of a single phase transformer.**		
M1.01	Explain the working principle of transformer	3	Understanding
M1.02	Derive the EMF equation of a transformer and solve problems.	3	Applying
M1.03	Illustrate the phasor diagrams of transformers.	3	Understanding
M1.04	Constructthe equivalent circuit of a single phase transformer.	5	Applying

Contents:
Single phase transformers-working principle-constructional details-classifications – core type - shell type

EMF equation: derivation of emfequation-transformation ratio - simple problems

Phasor diagram of transformer: ideal transformer-concept- working-phasor diagram Practical transformer - concept- transformer on no-load -vector diagrams (with winding resistance and leakage reactance)

Equivalent circuit parameters - referred to primary and secondary - simple problems- transformer on load – phasor diagrams at various power factors- derive the equation for voltage drop in a transformer- equivalent circuit of a transformer -problems

CO2	**Apply various tests to pre-determine and determine the performance of a transformer.**		
M2.01	Utilize SC and OC teststopre-determine efficiency and regulation of a transformer	6	Applying
M2.02	Apply direct load test to determine the efficiency and regulation of a transformer	3	Applying
M2.03	Outlinethe working of an autotransformer and instrument transformers	3	Understanding
M2.04	Illustrate the inter-connections of three phase transformers and cooling of transformers	3	Understanding
	Series Test - I	1	

Contents:

Efficiency and regulation of a transformer -testing of transformers- polarity test-open circuit test-short circuit test - derive the condition for maximum efficiency-predetermination of efficiency and regulation – problems.- develop equivalent circuit from sc and oc test data -problems

Load test on transformer- efficiency and regulations - simple problems-why transformer ratingin kVA -all day efficiency - definition-problems

Autotransformer-working principle – derivation of saving of copper – advantages – disadvantages – applications.

Instrument transformers-CT-PT-Working - applications

Three phase transformer –various connections – (star-star, star-delta, delta-delta, delta-star) -parallel operation ofthree phasetransformers-necessity- conditions

Cooling of transformers- basic concepts and methods

CO3	**Identify various torques andpower stages in three phase induction motor.**		
M3.01	Explain the working ofthree phase induction motor	4	Understanding
M3.02	Classify different torques in three phase induction motor	2	Understanding
M3.03	Illustrate the power stagesof a three phase induction motor and solve problems	4	Applying
M3.04	Developthe equivalent circuit of a three phase induction motor	4	Understanding

Contents:

Three phase induction motor-production of rotating magnetic field- construction - slip ring and squirrel cage rotors-synchronous speed-motor speed- Slip- frequency of rotor induced EMF - rotor power factor - simple problems.

Torque in an induction motor- relation between torque and rotor power factor- concept of standstill - derivations- starting torque– condition for maximum starting torque-torque under running conditions-derivations- torque - condition for maximum torque -concepts of full-load torque and maximum torque - torque-slip characteristics-crawling, cogging.

Power Stages :Losses and efficiency- power stages- problems-rotor torque and synchronous watt-problems

Equivalent Circuit of induction motor: Induction motor as a generalized transformer – equivalent circuits- simple problems- phasor diagrams.

CO4	**Construct circle diagram to pre-determine the performance of three phase induction motors and choose various methods for speed control.**		
M4.01	Selectvarious tests to pre-determine the performance ofthree phase induction motors	6	Applying
M4.02	Illustratevarious starting methods of three phase induction motors.	4	Understanding
M4.03	Classify speed control and braking methods of three phase induction motors.	3	Understanding
M4.04	Explain the construction and equivalent circuit ofdouble cage inductionmotor	2	Understanding
	Series Test - II	1	

Contents:

Testing of three phase induction motors - no load and blocked rotor tests - circle diagram – pre determination of performance and maximum quantities - problems.

Starting of induction motors - various starters - basic working and diagrams

Speed control of induction motors - different methods

Braking of induction motors - different methods

Double cage induction motor - construction - equivalent circuit

Applications of induction motors

Text / Reference:

T/R	Book Title/Author
T1	BL Theraja. Electrical technology. Vol- II: S Chand & co.
R1	JB Gupta. Theory and performance of electrical Machines: S. K. Kataria & Sons
R2	SK Sahdev. Electrical Machines. Cambridge university press

Online resources

Sl.No	Website Link
1	https://nptel.ac.in/courses/108/106/108106072
2	https://nptel.ac.in/courses/108/106/108106071
3	https://www.electrical4u.com/electrical-engineering-articles/electric-motor/
4	https://www.electrical4u.com/electrical-engineering-articles/transformer/
5	https://www.ee.iitb.ac.in/course/~emlab/lab-manual.html