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COURSE TITLE : POLY PHASE CIRCUITS TRANSFORMERS
COURSE CODE : 4036
COURSE CATEGORY : A
PERIODS/WEEK : 4
PERIOS/SEMESTER : 72
CREDITS ` : 4

TIME SCHEDULE

MODULE	TOPIC	PERIODS
I	Poly phase circuits	17
	Test I	1
II	Transformer principles	17
	Test II	1
III	Testing of transformers	17
	Test IIII	1
IV	Special purpose transformers	17
	Test IV	1
	TOTAL	**72**

Rationale

This subject is intended to teach the students about poly phase circuits and its application, Transformer construction and working principle and its application.

OBJECTIVES

MODULE I

1.1.0 Understand the poly phase circuits

1.1.1 Define ploy phase system
1.1.2 Describe the method of generation of ploy phase system (Detailed explanation with wave forms & vector diagram)
1.1.3 State the advantages of ploy phase system
1.1.4 Describe phase sequence and numbering system in ploy phase system
1.1.5 Explain inter connection of ploy phase
1.1.6 Draw the phaser diagram and derive the relation between the line and phase quantities in star and delta connection
1.1.7 Calculate the power and power factor in a 3 phase system using line and phase quantities
1.1.8 Differentiate between KVA, KW and KVAR referred to A.C circuits
1.1.9 Identify the balanced and unbalanced loads in three phase system
1.1.10 Explain Star/delta and Delta /star conversion (Balanced)

1.1.11 Solve problems in balanced Star/delta and Delta /star conversion
1.1.12 Explain the 3 phase power measurement by single, three and two watt meters (Balanced load)
1.1.13 Derive three phase power by two wattmeter with vector diagrams in star and delta connection (Balanced load)
1.1.14 Solve problems in power measurement

MODULE II

2.1.0 Understand the Transformer Principles & working

2.1.1 State the working principles of transformer
2.1.2 Describe the constructional details and classification of transformers
2.1.3 Identify the materials for core
2.1.4 Study the different types of insulation used
2.1.5 Sketch the 1 phase and 3 phase transformer
2.1.6 Derive the e.m.f equation of transformer
2.1.7 Compute the unknown quantities applying e.m.f equation
2.1.8 Identify the two components of no –load current
2.1.9 Represent the flux, e.m.f & no-load current and its components in a vector diagram
2.1.10 Differentiate between the mutual flux and leakage flux along with their magnetic path
2.1.11 Explain the primary and secondary leakage reactance
2.1.12 Draw the vector diagram under load condition, under different power factor
2.1.13 Understand the equivalent impedance resistance and reactance referred to primary and secondary
2.1.14 Solve the problems on e.m.f equations and equivalent impedance reactance and resistance
2.1.15 Identify the losses in transformers
2.1.16 Draw and analyze approximate equivalent circuit
2.1.17 Derive an expression for the approximate voltage drop
2.1.18 Define voltage regulation
2.1.19 Define percentage resistance, reactance and impedance drop
2.1.20 Compute the percentage regulation of given load condition and transformer parameter
2.1.21 Define per unit values of resistance reactance and impedance
2.1.22 Enumerate the losses
2.1.23 Obtain the condition of maximum efficiency and determine the corresponding Load

MODULE III

3.1.0 Know the Testing of Transformers
3.1.1 Understand the procedure for polarity and ratio test
3.1.2 Compute regulation and efficiency by data obtained from O.C and S.C test on Transformer

31.3 Calculate voltage regulation and efficiency by predetermined data obtained from O.C and S.C tests
3.1.4 Obtain the equivalent circuit parameters from O.C and S.C test data and draw the equivalent circuit
3.1.5 Describe the procedure of direct load test on 1 phase transformer, determine efficiency and regulation
3.1.6 Understand the applications of three-phase transformer and method of connections
3.1.7 Sketch and explain open delta connection
3.1.8 Distinguish between the power transformer and distribution transformer
3.1.9 Understand the need of tertiary winding
3.1.10 Define the term all day efficiency and compute All day efficiency from given data with reference to distribution transformer

MODULE 1V

4.1.0 Understand the Principle and Application of Special Purpose Transformers
4.1.1 Draw the constructional details of auto transformers
4.1.2 Differentiate between 2 winding and single winding transformers based on power transferred by induction and conduction
4.1.3 Compute the amount of copper saving in an auto transformer as compared to a 2 winding transformer of the same capacity and voltage ratio
4.1.4 State the applications of auto transformer
4.1.5 Identify the advantages and disadvantages of auto transformer over 2 winding transformer
4.1.6 State the need for voltage control by tap changing systems
4.1.7 Identify the principle and methods of tap changing
4.1.8 State the applications of OFF load and ON load tap changing based on principle of operations
4.1.9 Relate the temperature raise and losses in a transformer
4.1.10 List out the various methods of cooling transformers as per ISI standard
4.1.11 Draw the details of different types of cooling system
4.1.12 Understand the principle of current transformer
4.1.13 State the specifications of C.T, class of accuracy of C.T
4.1.14 State the practical applications of C.T
4.1.15 Understand the Precautions for C.T connections
4.1.16 Explain the Principle of P.T.
4.1.17 Show the Specifications and list applications of P.T

COURSE CONTENT

MODULE I

Polyphase circuits

Generation of ploy phase voltages, - advantages, phase sequence. Inter connection of three phases, star and delta connection. Relation between phase and line voltages and current in star and delta derivation with phase diagram.

Simple problem. Derivation of expression for power in three-phase system in star and delta. Calculation of power, current and power factor in a three phase balanced system. Balanced and unbalanced three phase system (only principle).

Balanced star - delta and delta - star conversion - problems

Three-phase power measurements - single wattmeter, three-watt meter and two-watt meter methods. Two-watt meter method of power measurement (balanced star and delta). Derivation with vector diagram, problems.

MODULE II

Transformer Principles.

Principle – advantages - construction and classification -core- shell, radial types - core materials – grain oriented silicon steel - insulation - different types of insulation - construction of single phase transformer- three phase transformer - explosion vent - breather - conservator tank etc. – e m f equation - transformation ratio - step up and step down transformers Transformer on no load - Vector diagram - component of no load current - no load parameters and no load losses - Transformer on load - difference between leakage flux and mutual flux - Primary and secondary leakage reactance - transformer constants on load. Vector diagram of transformer on load with different power factors - equivalent impedance as referred to primary and secondary.

Simple problems on determination of primary current, secondary current and efficiency based on approximate equivalent circuit - determination of approximate voltage drop – exact voltage drop – equivalent circuit

Voltage regulation- definition – percentage – regulation - percentage impedance - permit values of resistance -reactance and impedance -Problems - losses and efficiency - condition of maximum efficiency - KVA output at maximum efficiency - Problems

MODULE III

Testing of Transformers - Polarity tests - Ratio tests - open circuit test - short circuit test - load test on single-phase transformer as per BIS code of practice - Determination of transformer parameters such as percentage resistance, percentage reactance and percentage impedance - Predetermination of efficiency and regulation at various loads and power factors .Three phase transformer- connection -methods of connection - vector group - specific areas of applications - Open delta connection - Distinction between power transformer and distribution transformer - tertiary winding and its use- Define the term All day efficiency and compute All day efficiency from given data with reference to distribution transformer-problems.

MODULE 1V

Special purpose transformers

Auto transformers – constructions - saving of copper, fields of applications - advantage and disadvantages over two winding transformers - necessity of tap changing - OFF LOAD tap changing system and ON LOAD tap changing - Automatic tap changing systems .Necessity of cooling - classification of transformer based on method of cooling - Describe with sketches .Instrument transformers:- current transformers: schematic diagram-specifications -uses of C .T, Applications of C.T in current and power measurements - class of accuracy of CT & PT Potential transformers: Schematic diagram – specification ,applications - precautions in the use of P.T

TEXT BOOKS:

1. Electrical Technology-Vol 1 & 11 B.L.Theraja
2. Electric Machinery And Transformers Irving L.Kosow