MD TANVEER ALAM

20JE0557

Experiment – 5

Title:- Study the parallel operation of two three-phase transformers belonging to same vector groups.

Objective:- To check the vector groups of two three-phase transformers and to operate them in parallel.

Apparatus Required:-

S.No.	Name	Quantity	Range	Maker's Name
1.	3-ϕ Transformer.	2	3KVA	Concept. Int.
2.	3-ϕ Auto Transformer.	1	32A(0-230V)	Concept. Int.
3.	Digital phase angle meter.	1	(0-360°)	Concept Int.
4.	MCB.	1	–	–

Theory:- The need for parallel operation of three-phase transformers arises more frequently, since the generation, transmission & distribution of power is always three phase. The advantages of using two or more transformers in parallel over the use of one large unit, are (i) the power system becomes more reliable. (ii) Transformers can be switched off or on, depending upon the power demand. (iii) The cost of stand by unit is much less when two or more transformers are installed. The various conditions which must be fulfilled for the satisfactory parallel operation of two or more transformers, are as follows, (i) Same voltage rating, (ii) same polarity (iii) same phase sequence and (iv) same phase shift.

Three-phase transformers may have the following four standard connections.

(a) Star-Delta (Y-Δ)
(b) Delta-Star (Δ-Y)
(c) Delta-Delta (Δ-Δ)
(d) Star-Star (Y-Y)

A bank of three transformer or a three-phase transformer may have its primary & secondary windings connected in star, delta or zig-zag. The choice of particular connections depends upon the service conditions. In representing a three-phase transformer, the high voltage (H.V) winding is indicated by a capital letters (eg. Y for star, D for Delta) and low voltage (L.V) ~~winding~~ winding by a lower case letter (eg. y for star & d for Delta). The symbol "Yd" represents a three-phase transformer with hv in star & lv in delta. In the various transformer connections, the hv line emf & corresponding lv line emf may or may not have a phase displacement between them. This line phase displacement can ~~have~~ be expressed either in degrees or by a much more convenient method known a clock method of angle designation. According to this method, the hv line phasor is considered as the minute hand always set at 12 o' clock (zero hour) is position & the corresponding lv line phasor represented by hour hand. For two winding three-phase transformers, as per the clock method, first symbol represents hv & lv line emfs expressed as clock hour number. For example, symbol "Yd 11" represents a polyphases transformer with hv winding in star, lv winding in delta & the lv line

Teacher's Signature :

Circuit Diagram:-

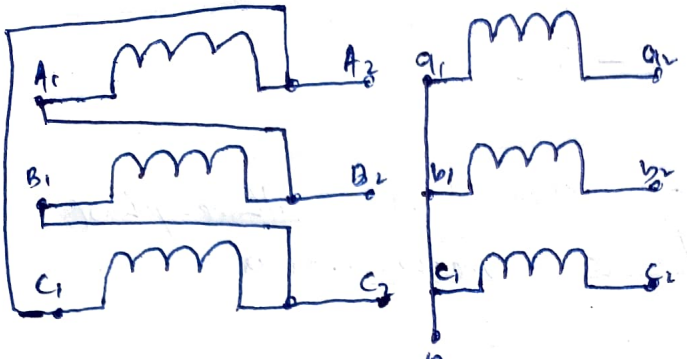

Fig 1. Dy11 arrangement

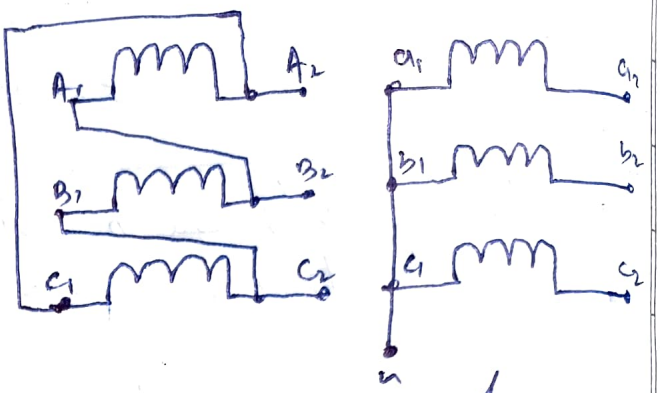

Fig 2: Dy11 arrangement

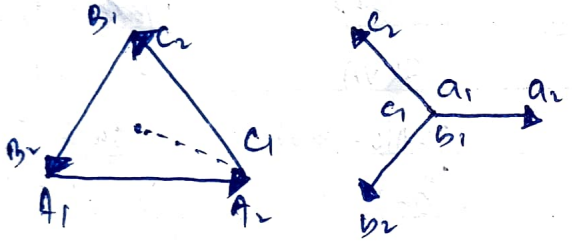

Fig 3. phasor Diagram of Dy11

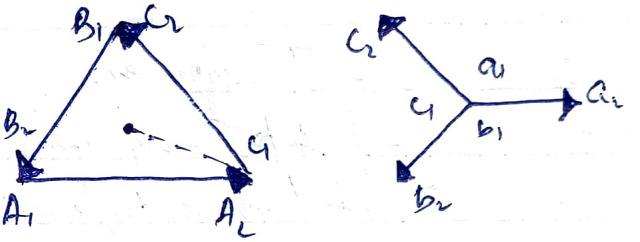

Fig 4. Phasor Diagram of Dy11

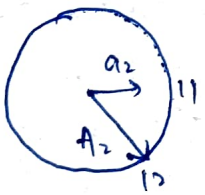

Fig 5: clock diagram of Dy11

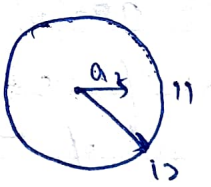

Fig 6. clock diagram of Dy11

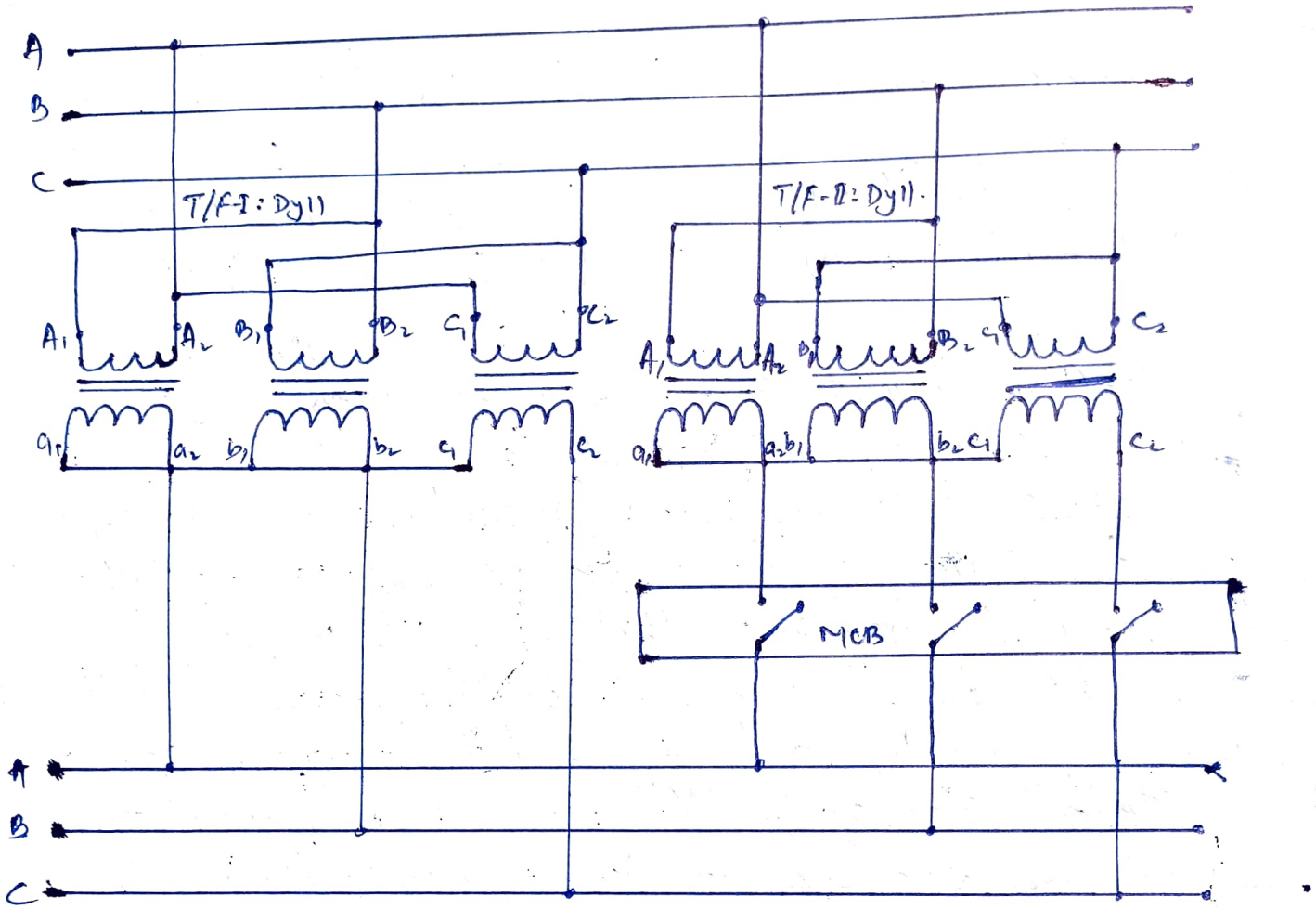

Fig. 7: Connection diagram for parallel operation of two three phase transformers belonging to same vector groups.

phasor at 11 o' clock, i.e, 30° ahead of the zero hour position of the hv line phasor.

Vector group: Vector group denotes for how much angle line to neutral voltage of lv side lead or lag by line to neutral voltage of hv side. Vector ~~groups~~ groups can be divided into four groups as follows

(a) Group No. 1 (0° phase displacement): Yy0° or Yy12, Dd0° or Dd12.
(b) Group No. 2 (180° phase disp.): Yy180° or Yy6, Dd180° or Dd6.
(c) Group No. 3 (Minus 30° phase drop): Yd-30° or Yd1, Dy-30° or Dy1.
(d) Group No. 4 (plus 30° phase disp.): Yd+30° or Yd11, Dy+30° or Dy11.

Observation Table:-

Transformer-I : Dy11			Transformer-II : Dy11		
Line to line voltage		Phase angle diff.	Line to line voltage		Phase angle diff.
hv side	lv side		hv side	lv side	
$V_{A_1B_1}$	$V_{a_2b_2}$	327°	$V_{A_1B_1}$	$V_{a_2b_2}$	327°
$V_{B_1C_1}$	$V_{b_2c_2}$	327°	$V_{B_1C_1}$	$V_{b_2c_2}$	327°
$V_{C_1A_1}$	$V_{c_2a_2}$	327°	$V_{C_1A_1}$	$V_{c_2a_2}$	327°

Results:- The parallel operation of two three phase transformers has been performed & studied successfully by checking their voltage phasors.

Precautions:- 1. Loose connections should not be made. (Tight connections).
2. Live wire should not be touched
3. Power supply should be switched off while making connections.