Ref No:

Sri Krishna Institute of Technology, Bengaluru-560090

COURSE PLAN

Academic Year - 2019-2020

Academic Evaluation and Monitoring Cell

Program:	BE- Electrical and Electronics Engineering
Semester:	3
Course Code:	18EEL37
Course Title:	ELECTRICAL MACHINE LAB-1
Credit/L-T-P:	2/0-2-2
Total Contact Hours:	40
Course Plan Author:	Avinash S

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INSTRUCTIONS TO TEACHERS

- Classroom / Lab activity shall be started after taking attendance.
- Attendance shall only be signed in the classroom by students.
- Three hours attendance should be given to each Lab.
- Use only Blue or Black Pen to fill the attendance.
- Attendance shall be updated on-line & status discussed in DUGC.
- No attendance should be added to late comers.
- Modification of any attendance, over writings, etc is strictly prohibited.
- Updated register is to be brought to every academic review meeting as per the COE.

Note : Remove “Table of Content” before including in CP Book

18EEL37 : ELECTRICAL MACHINE LAB-1

A. LABORATORY INFORMATION

1. Lab Overview

Degree:	B.Tech	*Program:*	EE
Year / Semester :	2/ 3	*Academic Year:*	2019
Course Title:	Electrical Machine Lab-1	*Course Code:*	18EEL37
Credit / L-T-P:	2/ 0-2-2	*SEE Duration:*	180 Minutes
Total Contact Hours:	40 Hrs	*SEE Marks:*	60Marks
CIA Marks:	40	*Assignment*	1 / Module
Course Plan Author:	Avinash S	*Sign*	Dt :
Checked By:		*Sign*	Dt :

2. Lab Content

Unit	Title of the Experiments	Lab Hours	Concept	Blooms Level
1	a) Open Circuit and Short circuit tests on single phase step up or step down transformer and predetermination of Efficiency and regulation (b) Calculation of parameters of equivalent circuit by conducting Open Circuit and Short circuit test	3	Analysis of Losses in transformers	L4 Analyze
2	Sumpner's test on similar transformers and determination of combined and individual transformer efficiency	3	Analysis of Combined losses in transformers	L4
3	Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification given the Short circuit test data.	3	Analysis of load distribution	L4
4	Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load	3	Analysis of polarity connection	L4
5	Comparison of performance of 3 single-phase transformers in delta – delta and V – V (open delta) connection under load.	3	Analysis of connection in 3 phase transformers	L4
6	Scott connection with balanced and unbalanced loads.	3	Analysis of 3 phase-2phase conversion	L4
7	Separation of hysteresis and eddy current losses in single phase transformer.	3	Analysis of Seperation of losses	L4
8	Voltage regulation of an alternator by EMF and MMF methods.	3	Analysis of voltage in generators	L4
9	Voltage regulation of an alternator by ZPF method.	3	Analysis of voltage in alternators	L4
10	Slip test – Measurement of direct and quadrature axis reactance and predetermination of regulation of salient pole synchronous machines.	3	Analysis of speed when connected in load	L4
11	Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa.	3	Analysis of excitation of generators	L4
12	Power angle curve of synchronous generator	3	Analysis Power Angle curve of alternator	L4

3. Lab Material

Unit	Details	Available
1	Text books	
	Nagaranth kothari, V.Kamaraju McGraw Hill 5 th Edition, 2013.	In Lib
2	Reference books	
	B L Theraja	In dept
3	Others (Web, Video, Simulation, Notes etc.)	
		Not Available

4. Lab Prerequisites:

-	-	Base Course:		-	-
SNo	Course Code	Course Name	Topic / Description	Sem	Remarks
1	18EE44	Electrical machine	Knowledge of AC and DC generators	4	
2	18EE33	Transformers and generators	Knowledge on Transformer operation	3	

Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

5. General Instructions

SNo	Instructions	Remarks
1	Keep the lab neatly.	
2	Maintain silence.	
3	Maintain your lab observation and lab manual.	
4	Prepare your experiment in well advance.	
5	Do not leave the lab without in-charge staff permission.	
6	Do not move around in the lab.	
7	Do not misplace the equipments.	
8	Check the power supply before use.	
9	Maintain discipline in the lab.	
10	After completion of your experiment switch off the power supply.	

6. Lab Specific Instructions

SNo	Specific Instructions	Remarks
1	The equipment must be connected firmly to the mother ground	
2	The electrodes must be cleaned properly before use	
3	Before starting the experiment, make sure the electrodes are properly aligned to zero reading	
4	Any part of the equipment should not be touched	
5	Do not enter High-Voltage area without discharge	
6	Sudden High-Voltage should not be applied to the specimen	
7	Do not enter the test-bay while the equipments are in operation	
8	Ignore the first one reading as the air between the electrodes may be ionized	

B. OBE PARAMETERS

1. Lab / Course Outcomes

Sl no	COs	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
1	a) Open Circuit and Short circuit tests on single phase step up or step down transformer and predetermination of Efficiency and regulation (b) Calculation of parameters of equivalent circuit by conducting Open Circuit and Short circuit test	10	Analysisof Losses in transformers	Demonstrate	Unit Test, Viva Voce	L3
2	Sumpner's test on similar transformers and determination of combined and individual transformer efficiency	06	Analysis of Combined losses in transformers	Demonstrate	Assignment	L3
3	Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification given the Short circuit test data.	07	Analysis of load distribution	Demonstrate	Assignment and unit Test	L3
4	Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load	03	Analysis of polarity connection	Simulation	Assignment	L3
5	Comparison of performance of 3 single-phase transformers in delta – delta and V – V (open delta) connection under load.	03	Analysis of connection in 3 phase transformers	Tutorial	Unit test	L4
6	Scott connection with balanced and unbalanced loads.	03	Analysis of 3 phase-2phase conversion	Tutorial	Assignment	L4
7	Separation of hysteresis and eddy current losses in single phase transformer.	03	Analysis of Seperation of losses	Demonstrate	Assignment and unit Test	L4
8	Voltage regulation of an alternator by EMF and MMF methods.	03	Analysis of voltage in generators	Demonstrate	Assignment Viva Voce	L4
9	Voltage regulation of an alternator by ZPF method.	03	Analysis of voltage in alternators	Demonstrate	Assignment Viva Voce	L5
10	Slip test – Measurement of direct and quadrature axis reactance and predetermination of regulation of salient pole synchronous machines.	03	Analysis of speed when connected in load	Demonstrate	Assignment Viva Voce	L4
11	Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa.	03	Analysis of excitation of generators		Assignment	L4
12	Power angle curve of synchronous generator	03	Analysis Power Angle curve of alternator		Assignment Unit Test	L4
-	**Total**	**36hrs**	-	-	-	-

Note: Identify a max of 2 Concepts per unit. Write 1 CO per concept.

2. Lab Applications

SNo	Application Area	CO	Level
1	**Operation of practical transformer** under no - load , calculating of equivalent circuit parameters and predetermination of efficiency- commercial and all-day. Voltage regulation and its significance.	CO1	L3
2	Analysis of Combined losses in transformers under on - load condition	CO2	L3
3	parallel operation multiple transformers and load distribution	CO3	L3
4	Checking polarity connection during parallel operation of transformers	CO4	L3
5	Analysis of connection in 3 phase transformers when one of the phase fails	CO5	L4
6	Analysis of conversion of phase in 3 phase transformers	CO6	L4
7	Separation of hysteresis and eddy current losses in single phase transformer.	CO7	L4
8	Voltage regulation of an alternator	CO8	L4
9	Analysis of voltage in alternators	CO9	L5
10	Analysis of speed when connected in load	CO10	L4
11	Analysis of excitation of generators	CO11	L4
12	Analysis Power Angle curve of alternator	CO112	L4

Note: Write 1 or 2 applications per CO.

3. Articulation Matrix

(CO – PO MAPPING)

-	Course Outcomes	Program Outcomes												
#	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Level
18EEL37.1	Experimentally verify the characteristics of Transformer by open circuit and short ciruit	X	X											L3
18EEL37.2	Experimentally verify the characteristics of transformer using two similar transformers	X	X											L3
18EEL37.3	Analyze the load sharing of transformers		X		X									L3
18EEL37.4	Analyze of connection of transformer	X	X											L3
18EEL37.5	Analyze different winding connection of transformer.		X		X									L4
18EEL37.6	Analyze conversion of 3phase to 2phase	X	X											L4
18EEL37.7	Experimentally verify separation of of losses in synchronous generator	X	X											L4
18EEL37.8	Analyze the voltage regulation of different methods in generaor	X	X											L4
18EEL37.9	Analysis of voltage in alternators	X	X											L4
18EEL37.10	Analysis of speed when connected in load		X		X									L4
18EEL37.11	Analysis of excitation of		X		X									L4

	generators													
18EEL37.12	Analysis Power Angle curve of alternator		X		X									L4

Note: Mention the mapping strength as 1, 2, or 3

4. Mapping Justification

Mapping		Mapping Level	Justification
CO	**PO**	**-**	**-**
CO1	PO1	L3	Knowledge on Transformers during open circuit and short ciruit
CO1	PO2	L3	analysing the characteristics of Transformer by open circuit and short ciruit
CO2	PO1	L3	Knowledge on parallel operation of transformer using two similar transformers
CO2	PO2	L3	analysing the characteristics of transformer using two similar transformers
CO3	PO2	L3	analytical verification of two dissimilar single-phase transformers of different kVA
CO3	PO4	L3	Investigating the operation of two dissimilar single-phase transformers of different kVA and load sharing
CO4	PO1	L3	Knowledge of Transformers in different connection
CO4	PO2	L3	analytical verification of Transformers in different connection
CO5	PO2	L4	Analysis of connection in 3 phase transformers when one of the phase fails
CO5	PO4	L4	Devolpment of solution for 3 phase transformers when one of the phase fails
CO6	PO1	L4	Knowledge on 3phase transformer
CO6	PO2	L4	Analyze conversion of 3phase to 2phase
CO7	PO1	L4	Knowledge on synchronous generator
CO7	PO2	L4	analytical verification on separation of losses in synchronous generator
CO8	PO1	L4	Knowledge on voltage regulation of generator
CO8	PO2	L3	Analyze the voltage regulation of different methods in generator
CO9	PO1	L3	Knowledge on voltage regulation of generator
CO9	PO2	L3	Analysis of voltage in alternators
CO10	PO2	L4	Analysis of speed when connected in load
CO10	PO4	L4	Investigating the speed variations when connected to load
CO11	PO2	L4	Analysis on variable excitation of generators
CO11	PO4	L4	Investigating the variable excitation of generators
CO12	PO2	L4	Knowledge on Power Angle curve of alternator
CO12	PO4	L4	Analysis Power Angle curve of alternator

Note: Write justification for each CO-PO mapping.

5. Curricular Gap and Content

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					

Note: Write Gap topics from A.4 and add others also.

6. Content Beyond Syllabus

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					

Note: Anything not covered above is included here.

C. COURSE ASSESSMENT

1. Course Coverage

Unit	Title	Teaching Hours	No. of question in Exam							CO	Levels
			CIA-1	CIA-2	CIA-3	Asg-1	Asg-2	Asg-3	SEE		
1	a) Open Circuit and Short circuit tests on single phase step up or step down transformer and predetermination of Efficiency and regulation (b) Calculation of parameters of equivalent circuit by conducting Open Circuit and Short circuit test	03	1	-	-	-	-	-	1	CO1	L2
2	Sumpner's test on similar transformers and determination of combined and individual transformer efficiency	03	1	-	-	-	-	-	1	CO2	L3
3	Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification given the Short circuit test data.	03	1	-	-	-	-	-	1	CO3	L3
4	Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load	03	1	-	-	-	-	-	1	CO4	L3
5	Comparison of performance of 3 single-phase transformers in delta – delta and V – V (open delta) connection under load.	03	1	-	-	-	-	-	1	CO5	L4
6	Scott connection with balanced and unbalanced loads.	03	-	1	-	-	-	-	1	CO6	L4
7	Separation of hysteresis and eddy current losses in single phase transformer.	03	-	1	-	-	-	-	1	CO7	L4
8	Voltage regulation of an alternator by EMF and MMF methods.	03	-	1	-	-	-	-	1	CO8	L4
9	Voltage regulation of an alternator by ZPF method.	03	-	1	-	-	-	-	1	CO9	L4
10	Slip test – Measurement of direct and quadrature axis reactance and predetermination of regulation of salient pole synchronous machines.	03	-	1	-	-	-	-	1	CO10	L4
11	Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa.	03	-	-	1	-	-	-	1	CO11	L4
12	Power angle curve of synchronous	03	-	-	1	-	-	-	1	CO12	L4

	generator										
-	**Total**	**36**	**5**	**5**	**5**	**5**	**5**	**5**	**20**	**-**	**-**

Note: Write CO based on the theory course.

2. Continuous Internal Assessment (CIA)

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	30	CO1, CO2, CO3, CO4	L23, L3
CIA Exam – 2	30	CO5, CO6, CO7,	L1, L2, L3 . .
CIA Exam – 3	30	CO5, CO6,	L1, L2, L3 . .
Assignment - 1	05	CO1, CO2, CO3, CO4	L2, L3, L4 ...
Assignment - 2	05	CO5, CO6, CO7,	L1, L2, L3 ...
Assignment - 3	05	CO8,	L1, L2, L3 ...
Seminar - 1	05	CO1, CO2, CO3, CO4	L2, L3, L4 . ..
Seminar - 2	05	CO5, CO6,	L2, L3, L4 . ..
Seminar - 3	05	CO8,	L2, L3, L4 . ..
Other Activities – define – Slip test		CO1	L2, L3, L4 . ..
Final CIA Marks	**40**	**-**	**-**

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SNo	Description	Marks
1	Observation and Weekly Laboratory Activities	05 Marks
2	Record Writing	10 Marks for each Expt
3	Internal Exam Assessment	25 Marks
4	Internal Assessment	15 Marks
5	SEE	80 Marks
-	**Total**	**100 Marks**

D. EXPERIMENTS

Experiment 01 : OPEN CIRCUIT & SHORT CIRCUIT TEST ON A SINGLE PHASE TRANSFORMER:

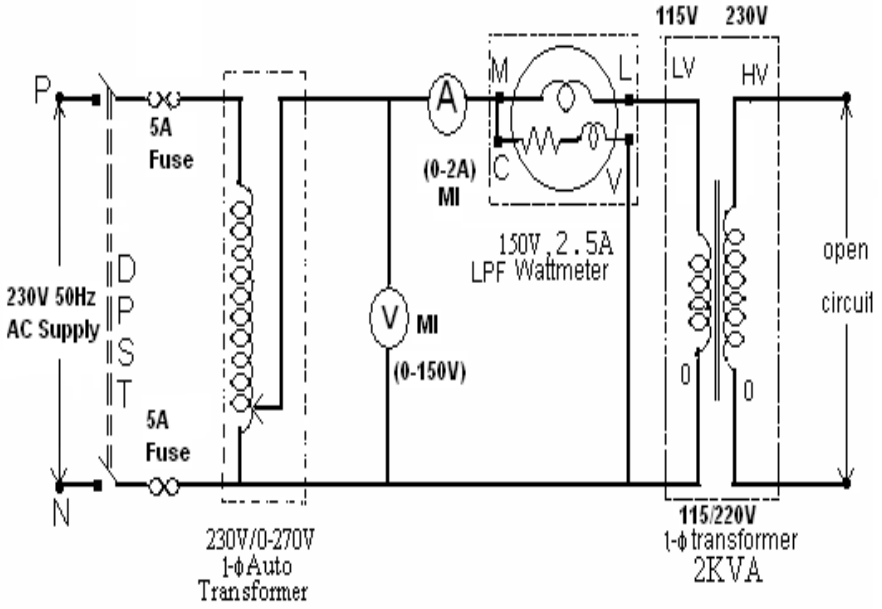
-	**Experiment No.:**	1	**Marks**		**Date Planned**		**Date Conducted**	
1	Titlle	OPEN CIRCUIT & SHORT CIRCUIT TEST ON A SINGLE PHASE TRANSFORMER						
2	Course Outcomes	Experimentally verify the characteristics of Transformer by open circuit and short ciruit						
3	Aim	To perform open circuit and short circuit test on a single phase transformer and to pre-determine the efficiency, regulation and equivalent circuit of the transformer						
4	Material / Equipment Required							

Sl.No.	equipment	Type	Range	Quantity
1	Voltmeter	MI	(0-300)V , (0-150)V	1 no, 1 no
2	Ammeter	MI	(0-2)A , (0-20)A	1 no, 1 no
3	Wattmeter	Dynamo type	(0-300)V (0-2)A LPF	1 no
4	Wattmeter	Dynamo type	(0-150)V (0-10)A UPF	1 no

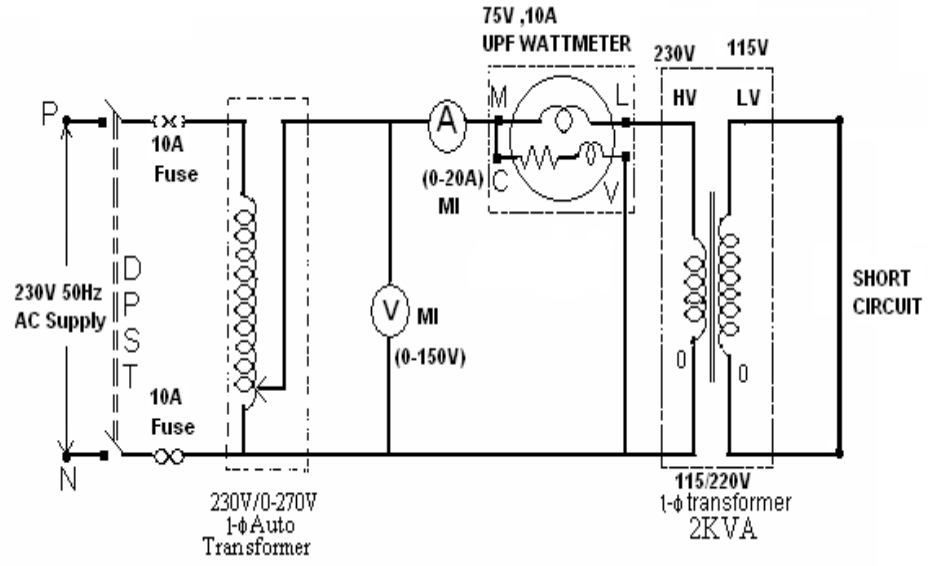
5	Theory, Formula, Principle, Concept	Find the equivalent circuit parameters R0, X0, R01, R02, X01 and X02 from the O. C. and S. C. Test results and draw the equivalent circuit referred to L. V. side as well as H. V. side No load power factor, **cos**$\hat{\phi}_o$= Wo / (Vo*Io) Short circuit power factor, **cos**$\hat{\phi}_{sc}$ = Wsc / (Vsc*Isc).

		$R_o = \frac{V_1}{I_w}$ where Iw = Io cosΦo $X_0 = \frac{V_1}{I_m}$ Where Im = Io sin Φo $R_{01} = \frac{W_{sc}}{I_{sc}^2}$ $X_{01} = \sqrt{Z_{01}^2 - R_{01} b^2}$ $Z_{01} = \frac{V_{sc}}{I_{sc}}$ $X_{02} = K^2 X_{01}$ Where K = $\frac{V_2}{V_1}$ = Transformation Ratio
6	Procedure, Program, Activity, Algorithm, Pseudo Code	**Open circuit test:** 1. Connections are made as per the circuit diagram. 2. Ensure that variac is set to zero output voltage position before starting the experiment. 3. Switch ON the supply. Now apply the rated voltage to the Primary winding by using Variac. 4. The readings of the Voltmeter, ammeter and wattmeter are noted down in Tabular form. 5. Then Variac is set to zero output position and switch OFF the supply. 6. Calculate **R_o** and **X_o** from the readings. **Short Circuit Test:** 1. Connections are made as per the circuit diagram. 2. Ensure that variac is set to zero output voltage position before starting the experiment. 3. Switch ON the supply. Now apply the rated Current to the Primary winding by using Variac. 4 The readings of the Voltmeter, ammeter and wattmeter are noted down in Tabular form. 5. Then Variac is set to zero output position and switch OFF the supply. 6. Calculate **R_{o1}** and **X_{o1}** from the readings.

7 Block, Circuit, Model Diagram, Reaction Equation, Expected Graph



8 Observation Table, Look-up Table, Output



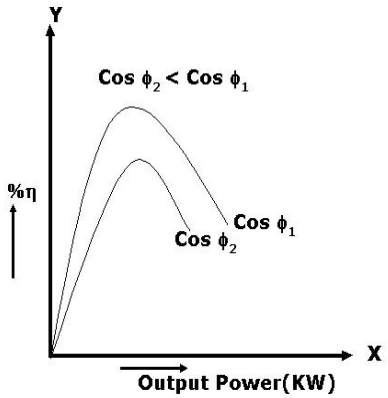
For OC test

I) For OC test

Sl no.	Voltmeter reading (V_o)	Ammeter reading (I_o)	Wattmeter reading W_o	R_o	X_o	Cos ϕ_o

II) SC test

Sl no.	Voltmeter reading	Ammeter reading	Wattmeter reading	R_{o1}	Z_{o1}	X_{o1}

			(V_{SC})	(I_{SC})	W_{SC}			
9	Sample Calculations	Calculations to find efficiency and regulation For example at ½ full load Cupper losses = Wsc x $(1/2)^2$ watts, where WSC = full – load cupper losses Constant losses = Wo watts Output = ½ KVA x cos Φ [cos Φ may be assumed] Input = output + Cu. Loss + constant loss $\%Efficiency = \frac{output}{input} x\,100$						
10	Graphs, Outputs							
11	Results & Analysis	hence performed open circuit and short circuit test on a single phase transformer and to pre-determine the efficiency, regulation and equivalent circuit of the transforme						
12	Application Areas	Used in Generation , Transmission and Distribution						
13	Remarks							
14	Faculty Signature with Date							

Experiment 02 : Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.

-	**Experiment No.:**	1	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	Sumpner's test						
2	Course Outcomes	Experimentally verify the characteristics of transformer using two similar transformers						
3	Aim	1) To conduct sumpner's test (heat run test) on two identical transformers and hence to Predetermine the efficiency and regulation. 2) Determine combined and individual transformer efficiency.						
4	Material / Equipment Required							

Sl No	PARTICULARS	RANGE	TYPE	QUANTITY
1	Ammeter	0-2A	MI	1
		0-10A	MI	1
2	Voltmeter	0-300V, 0-60V, 0-600V	MI	3
3	Wattmeter	1A,300V 10A,75V	LPF UPF	1 1
4	Transformer	1KVA	1-Φ	2

		5	Autotransformer	-	-	2
		6	SPST Switch	-	-	1

5 Theory, Formula, Principle, Concept

Total iron loss of both the transformers = W_1 Watts.

Total copper loss of both the transformers = W_2 watts.

Iron loss/ transformer = $W_{IRON} = W_1 / 2$ Watts.

Copper loss / transformer = $W_{COPPER} = W_2/2$ Watts

$$\text{Losses in each transformer} = \frac{W_i + W_c}{2}$$

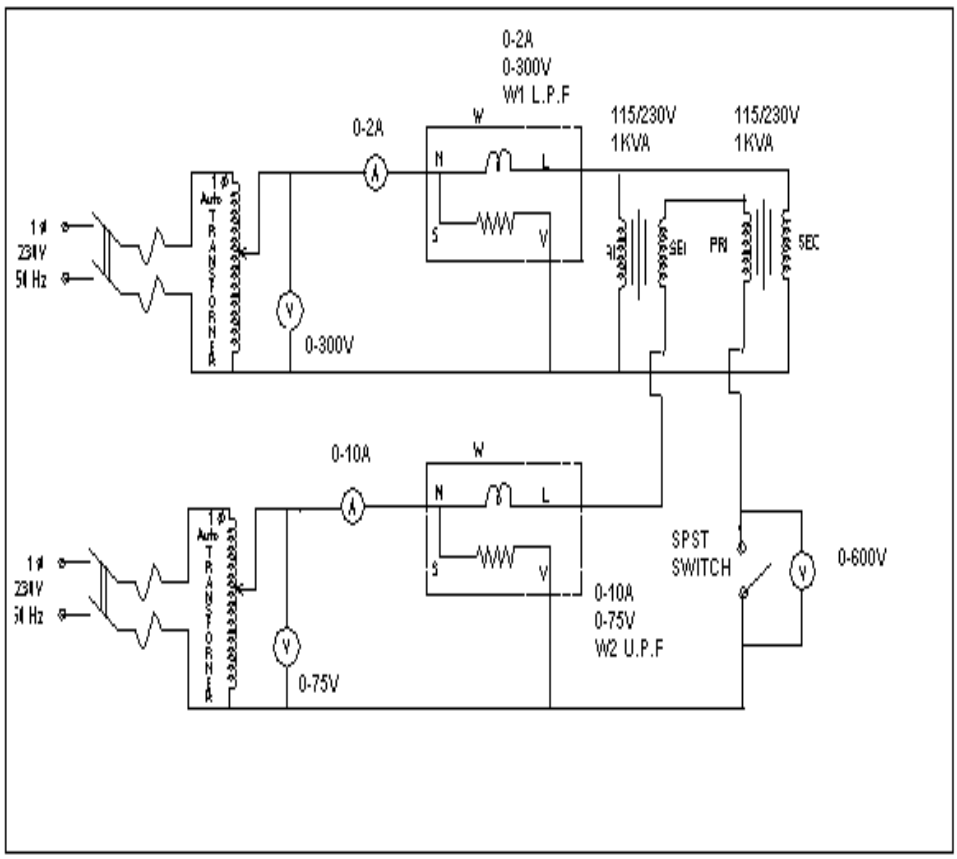
$$\%\eta \text{ combined} = \frac{VI_1}{VI_1 + W_i + W_c} x\ 100$$

$$\text{Efficiency of each transformer } (\%\eta) = \frac{VI_1}{VI_1 + \frac{W_i}{2} + \frac{W_c}{2}} x100$$

The efficiency can be found out at unity power factor (Cos φ = 1) for different values of load factor.

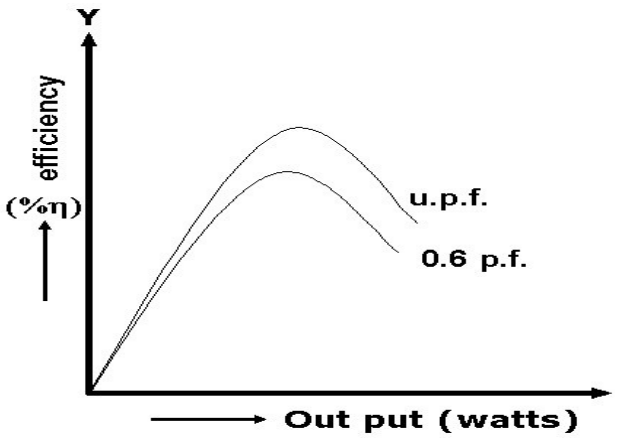
6 Procedure, Program, Activity, Algorithm, Pseudo Code

7 Block, Circuit, Model Diagram, Reaction Equation, Expected Graph



8 Observation Table, Look-up Table, Output

I_1 Amps	W_1*K_1 Watts	I_2 Amps	W_2*K_2 Watts

9	Sample Calculations	Wattmeter Constant, $K = \frac{V_{selected} X I_{selected} X p.f}{Maximum\ Scale\ of\ Wattmeter}$ Wattmeter Constant, K_1= Wattmeter Constant, K_2= **CALCULATIONS:** Total iron loss of both the transformers = W_1 Watts. Total copper loss of both the transformers = W_2 watts. Iron loss/ transformer = $W_{IRON} = W_1 / 2$ Watts. Copper loss / transformer = $W_{COPPER} = W_2 / 2$ Watts Losses in each transformer = $\frac{W_i + W_c}{2}$ %η combined = $\frac{VI_1}{VI_1 + W_i + W_c} x\ 100$ Efficiency of each transformer (%η)= $\frac{VI_1}{VI_1 + \frac{W_i}{2} + \frac{W_c}{2}} x100$ The efficiency can be found out at unity power factor (Cos φ = 1) for different values of load factor.
10	Graphs, Outputs	
11	Results & Analysis	
12	Application Areas	Used to protect highly sensitive and high rating electrical equipments
13	Remarks	
14	Faculty Signature with Date	

Experiment 03 : Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification given the Short circuit test data

-	Experiment No.:	1	Marks		Date Planned		Date Conducted	
1	Title	Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification given the Short circuit test data						
2	Course Outcomes	Analyze the load sharing of transformers						
3	Aim	To study the performance of two dissimilar single phase transformers when connected in Parallel & determination of load sharing and analytical verification given short circuit test data						

4 Material / Equipment Required

Sl No	PARTICULARS	RANGE	TYPE	QUANTITY
1	Transformer		1-Φ	2
2	Ammeter	0-10A, 0-5A, 0-2MA	MI	3
3	Voltmeter	0-600V, 0-300V	MI	2
4	Wattmeter	10A,150V, 20A,150V	UPF	2
5	SPST Switch	-	-	1

5 Theory, Formula, Principle, Concept

$$Z_B = \frac{V_{sc2}}{I_{sc2}} = ¿ ¿$$

$R_A = \frac{W_{sc1}}{I_{sc1}^2}$ = ----------Ω $R_B = \frac{W_{sc2}}{I_{sc2}^2}$ = ----------Ω

$X_A = ((Z_A)^2 - (R_A)^2)^{1/2}$ = _____Ω $X_B = ((Z_B)^2 - (R_B)^2)^{1/2}$ = _____Ω

$$I_A = \frac{I_L * Z_B}{Z_A + Z_B} = ¿ \, Amps \; I_B = \frac{I_L * Z_A}{Z_A + Z_B} = ¿ \, Amps$$

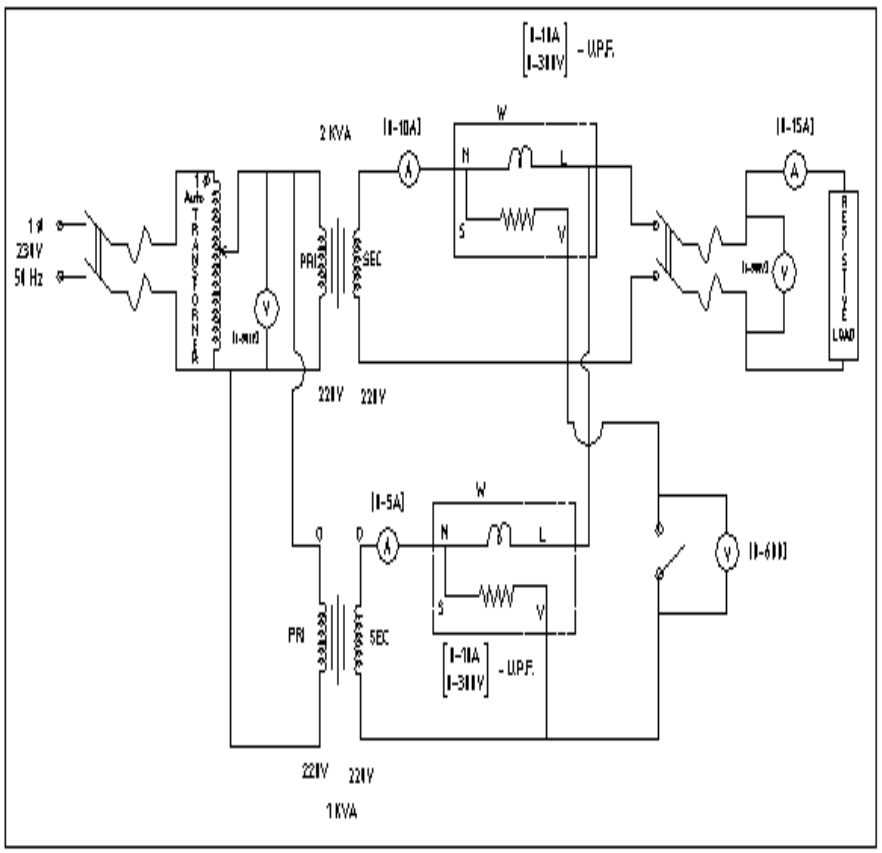
$$Q_A = \frac{Q * Z_B}{Z_A + Z_B} = ¿ \; Q_B = \frac{Q * Z_A}{Z_A + Z_B} = ¿ ¿$$

6 Procedure, Program, Activity, Algorithm, Pseudo Code

01. The circuit is rigged up as shown in the circuit diagram

02. Keep autotransformer in minimum position and the SPST switch is kept open; the main supply is switched ON. A small voltage (say 50V) is applied to the primaries of the transformers by varying the output of the variac.

Note: If the voltmeter across SPST switch shows zero reading, it indicates that the two secondary windings of the two transformers are connected properly. If the voltmeter shows some value other than zero, it indicates that the two secondary windings of the transformers are not connected

		properly. In that case, the output of the variac reduced to zero and the supply is switched OFF. Then the connections of the secondary terminals of any one of the transformers are interchanged. After interchange secondary terminals, the supply is switched ON and a small voltage is applied. Now, the voltmeter will show zero reading. **03.** The SPST switch is closed after confirming the zero voltage across it and the rated voltage of the transformer is applied to the primary windings. **04.** The no load readings of all the meters are noted down. **05.** The lamp loads are applied in equal steps and the corresponding meter readings are noted down and tabulated. **06.** Loading is continued till one of the transformers carries its rated current. **07.** The loads are reduced to zero, the output of variac is reduced to zero and the supply switch is opened. **08.** Now, the connections are removed and short circuit test is conducted on both the transformers separately, as explained in experiment number 01, and the readings are tabulated. 1. Bring the variac to minimum position and switch OFF the main supply. 2. Repeat the same procedure and note down 3 to 4 breakdown voltages.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table,	

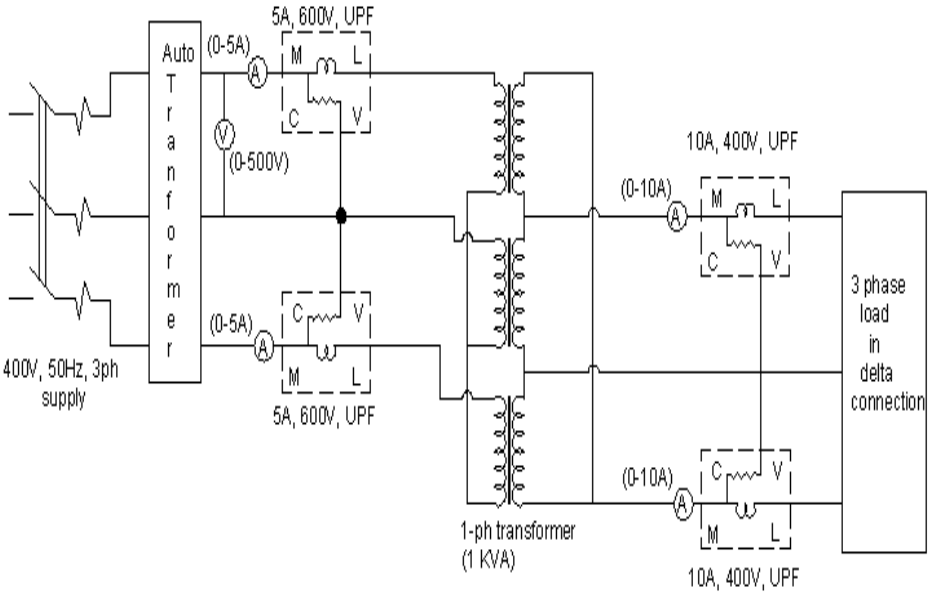
	Output	Sl. No.	I_A Amps	I_B Amps	I_L Amps	W_A watts	W_B Watts	V_L Volts	W_L watts
9	Sample Calculations								
10	Graphs, Outputs								
11	Results & Analysis	Breakdown strength of oil = (Breakdown voltage/ Distance between the two electrodes) in kV/ mm							
12	Application Areas								
13	Remarks								
14	Faculty Signature with Date								

Experiment 04 :Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.

	Experiment No.:	3	**Marks**	3	**Date Planned**		**Date Conducted**	
1	Title	Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.						
2	Course Outcomes	Analyze of connection of transformer						
3	Aim	To obtain the flash over characteristics of the following electrode configuration in air subjected to HVAC 1 Plane - plane electrodes 2 Point - point electrodes 3 Plane - point electrodes						
4	Material / Equipment Required							

Sl No	PARTICULARS	RANGE	TYPE	QUANTITY
1	Ammeter	0-5A 0-10A	MI MI	2 1
2	Voltmeter	0-30V	MI	2
3	Wattmeter	0-5A,0-400V	UPF	2
4	3Φ Load	-	-	1
5	3Φ Auto TFR	-	-	1
6	1Φ TFR of equal rating	1KVA	-	3

5	Theory, Formula, Principle, Concept	Let V_{L1}= Line voltage on primary side V_{L2} = Line voltage on secondary side V_{ph1} = phase voltage on primary side V_{ph2}= phase voltage on secondary side K= transformation ratio

		$V_{ph1} = \frac{V_{L1}}{\sqrt{3}}, \quad \frac{V_{ph2}}{V_{ph1}} = K$ Therefore $V_{ph2} = K\ V_{ph1} = K\frac{V_{L1}}{\sqrt{3}}$ Since secondary is connected in delta. $V_{ph2} = V_{L2}$ $V_{L2} = K\frac{V_{L1}}{\sqrt{3}} = \frac{K}{\sqrt{3}}V_{L1}$ Output $= W_3 + W_4$ = Input = $W_1 + W_2$ =
6	Procedure, Program, Activity, Algorithm, Pseudo Code	1. The circuit is rigged up as shown in the circuit diagram. 2. Keeping the load switch in minimum & the 3-phase autotransformer in minimum position, the 3-phase supply is switched closed. 3. The 3-phase autotransformer is varied to supply the rated voltage. 4. Gradually load is applied & at each step all the meter readings are noted down. 5. Load is applied until the rated current of the transformer is reached. 6. Gradually load is decreased, 3-phase autotransformer is bring back to initial zero position & supply switch is opened.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	

Sl. No	V_1 (v)	W_1xK (W)	W_2xK (W)	W_3xK (W)	W_4xK (W)	I_1 (A)	I_2 (A)	I_3 (A)	I_4 (A)	%η

9	Sample Calculations	%η = (Output/ Input)*100 = %Regulation= $(V_o - V_{1)} / V_0 * 100$ =
10	Graphs, Outputs	
11	Results & Analysis	
12	Application Areas	Used in industries generating stations
13	Remarks	
14	Faculty Signature with Date	

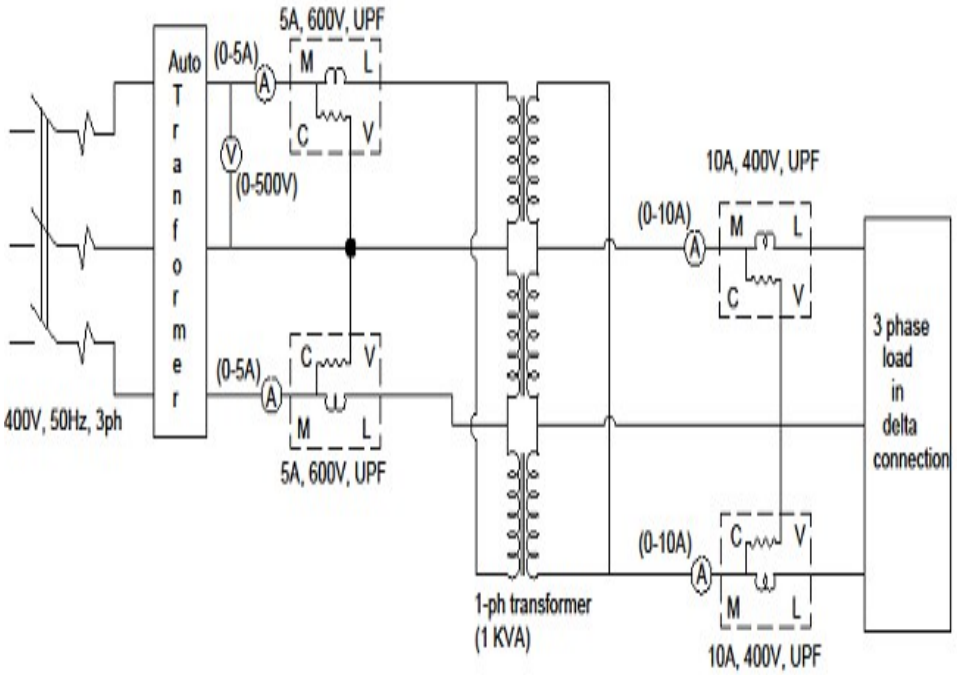
Experiment 05 : Comparison of performance of 3 single-phase transformers in delta – delta and V – V (open delta) connection under load.

-	**Experiment No.:**	1	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	Comparison of performance of 3 single-phase transformers in delta – delta and V – V (open delta) connection under load.						
2	Course Outcomes	Analyze different winding connection of transformer.						
3	Aim	To compare the performance of 3 single-phase transformers in delta – delta and v – v (open delta) connection under load						

4 Material / Equipment Required

Sl No	PARTICULARS	RANGE	TYPE	QUANTITY
1	Ammeter	0-5A, 0-10A	MI	2, 1
2	Voltmeter	0-30V	MI	2
3	Wattmeter	0-5A,0-400V	UPF	2
4	3Φ Load	-	-	1
5	3Φ Auto TFR	-	-	1
6	1Φ TFR of 1kVA brating	Equal	-	3

5	Theory, Formula, Principle, Concept	
6	Procedure, Program, Activity, Algorithm, Pseudo Code	

7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	

8 Observation Table, Look-up Table, Output

Sl. No	V_1 (v)	W_1xK (W)	W_2xK (W)	W_3xK (W)	W_4xK (W)	I_1 (A)	I_2 (A)	I_3 (A)	I_4 (A)	%η

9 Sample Calculations

Let V_{L1}= Line voltage on primary side
V_{L2} = Line voltage on secondary side
V_{ph1} = phase voltage on primary side
V_{ph2}= phase voltage on secondary side
K= transformation ratio

For delta connection, $V_{ph1} = V_{L1,}$ Now $\frac{V_{ph2}}{V_{ph1}} = K$

Therefore $V_{ph2} = K\ V_{ph1}$

But again since secondary is connected in delta.

$V_{ph2} = V_{L2} = K V_{L1}$

Output $= W_3 + W_4 =$

Input $= W_1 + W_2 =$

%η = (Output/ Input)*100 =

%Regulation= $(V_o - V_{1)} / V_0 * 100$ =

10 Graphs, Outputs

11 Results & Analysis

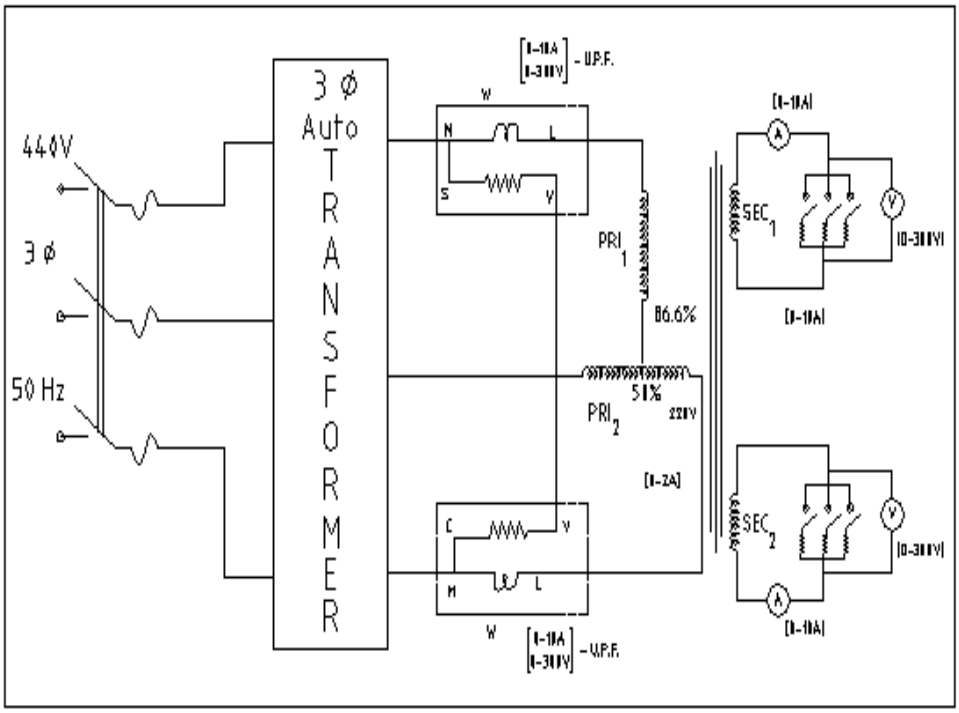
12 Application Areas To check the break-down voltage of a

13	Remarks	
14	Faculty Signature with Date	

Experiment 06 : Scott connection with balanced and unbalanced loads.

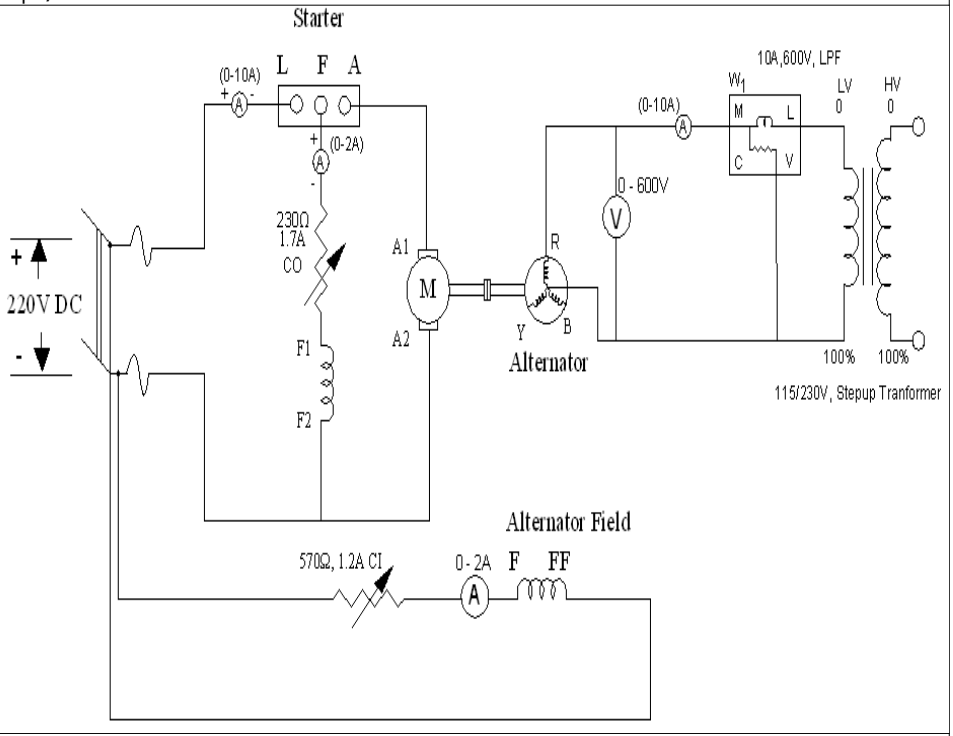
-	**Experiment No.:**	1	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	Scott connection with balanced and unbalanced loads						
2	Course Outcomes	Analyze conversion of 3phase to 2phase						
3	Aim	Scott connection with balanced and unbalanced loads.						
4	Material / Equipment Required							

Sl No	PARTICULARS	RANGE	TYPE	QUANTITY
1	Transformer tapings)	(With 2KVA	1-Φ	2
2	Ammeter	0-10A	MI	2
3	Voltmeter	0-300V	MI	2
4	Wattmeter	10A,300V	UPF	2

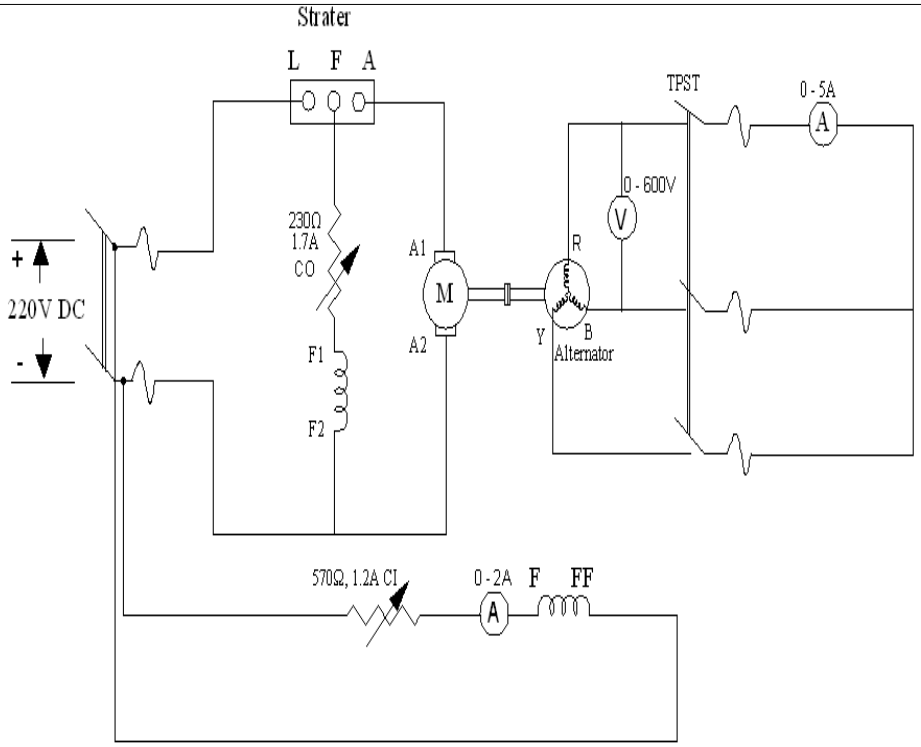
5	Theory, Formula, Principle, Concept	
6	Procedure, Program, Activity, Algorithm, Pseudo Code	step 1: step 2: step 3: step 4: step 5: step 6: step 7:
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	
9	Sample Calculations	
10	Graphs, Outputs	
11	Results & Analysis	

12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	

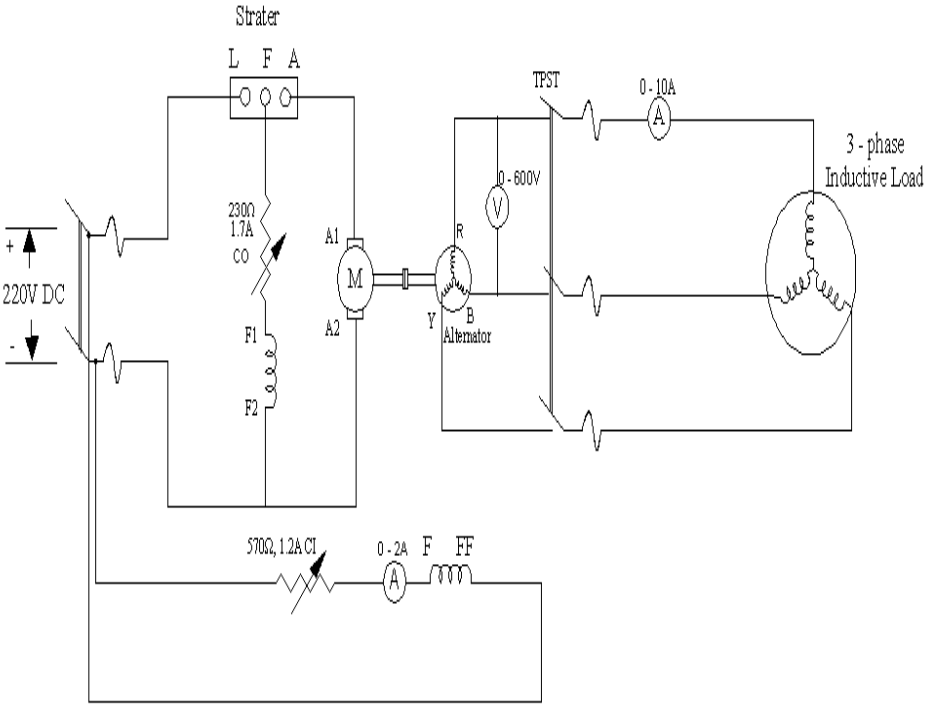
Experiment 07 : Separation of hysteresis and eddy current losses in single phase transformer.

-	**Experiment No.:**	1	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	Over Current Relay						
2	Course Outcomes							
3	Aim	Separation of hysteresis and eddy current losses in single phase transformer.						
4	Material / Equipment Required							
5	Theory, Formula, Principle, Concept							
6	Procedure, Program, Activity, Algorithm, Pseudo Code	step 1: step 2: step 3: step 4: step 5: step 6: step 7:						
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph							
8	Observation Table, Look-up Table, Output							
9	Sample Calculations							
10	Graphs, Outputs							
11	Results & Analysis							
12	Application Areas							
13	Remarks							
14	Faculty Signature with Date							

Experiment 08 : VOLTAGE REGULATION OF AN ALTERNATOR BY I) EMF METHOD II) MMF METHOD.

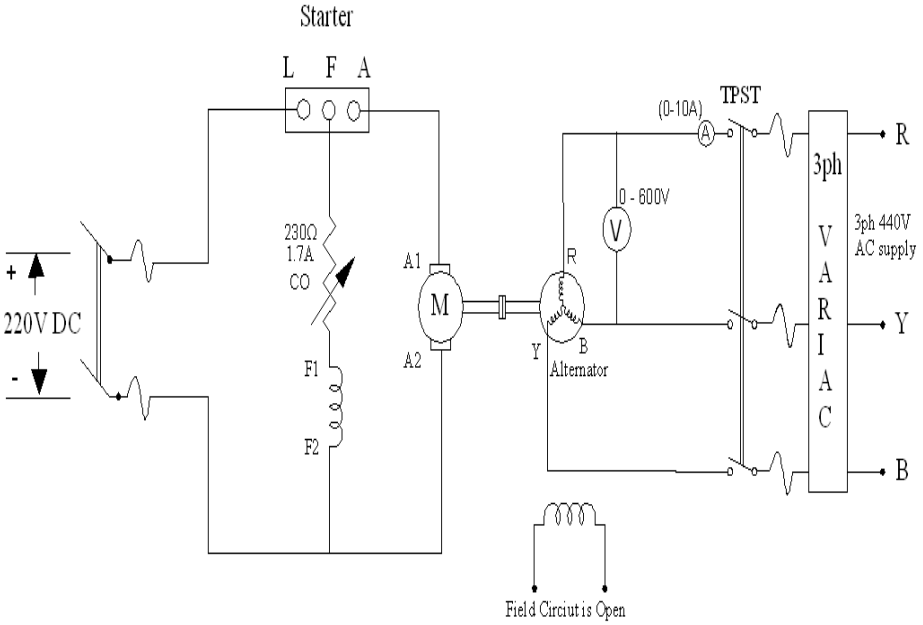
-	Experiment No.:	1	Marks		Date Planned		Date Conducted	
1	Title	Over Current Relay						
2	Course Outcomes							
3	Aim							
4	Material / Equipment Required							
5	Theory, Formula, Principle, Concept							
6	Procedure, Program, Activity, Algorithm, Pseudo Code	step 1: step 2: step 3: step 4: step 5: step 6: step 7:						
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph							
8	Observation Table, Look-up Table, Output							
9	Sample Calculations							
10	Graphs, Outputs							
11	Results & Analysis							
12	Application Areas							
13	Remarks							
14	Faculty Signature with Date							

Experiment 09 :VOLTAGE REGULATION OF AN ALTERNATOR BY ZPF METHOD.

-	Experiment No.:	1	Marks		Date Planned		Date Conducted	
1	Title	VOLTAGE REGULATION OF AN ALTERNATOR BY ZPF METHOD.						
2	Course Outcomes							
3	Aim							
4	Material / Equipment Required							
5	Theory, Formula, Principle, Concept							
6	Procedure, Program, Activity, Algorithm, Pseudo Code	step 1: step 2: step 3: step 4: step 5: step 6: step 7:						
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph							
8	Observation Table, Look-up Table, Output							
9	Sample Calculations							
10	Graphs, Outputs							
11	Results & Analysis							
12	Application Areas							
13	Remarks							
14	Faculty Signature with Date							

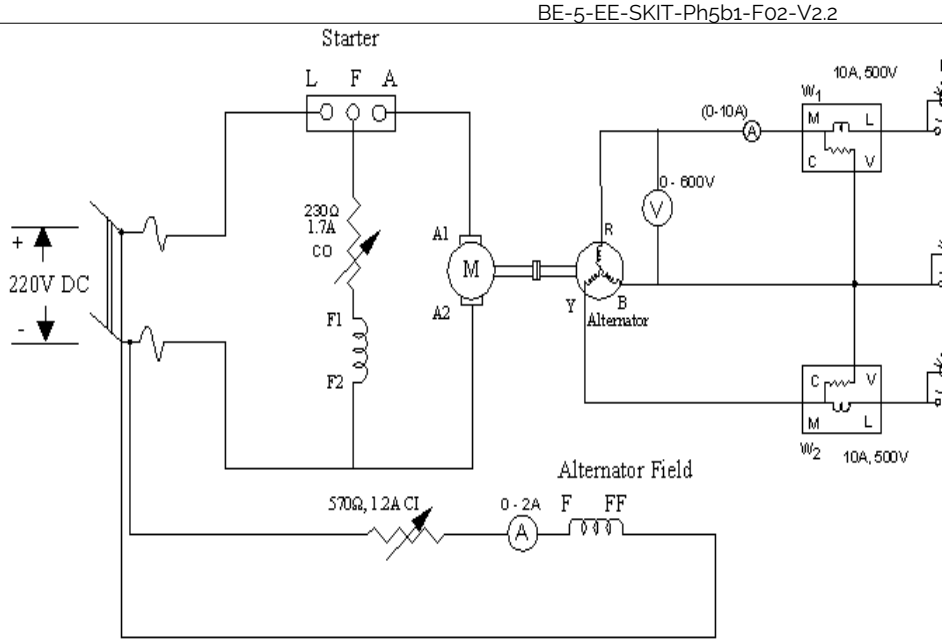
Experiment 10 : SLIP TEST ON SALIENT POLE ALTERNATOR

-	Experiment No.:	1	Marks		Date Planned		Date Conducted	
1	Title	SLIP TEST ON SALIENT POLE ALTERNATOR						
2	Course Outcomes							
3	Aim							
4	Material / Equipment Required							

5	Theory, Formula, Principle, Concept	
6	Procedure, Program, Activity, Algorithm, Pseudo Code	step 1: step 2: step 3: step 4: step 5: step 6: step 7:
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	
9	Sample Calculations	
10	Graphs, Outputs	
11	Results & Analysis	
12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	

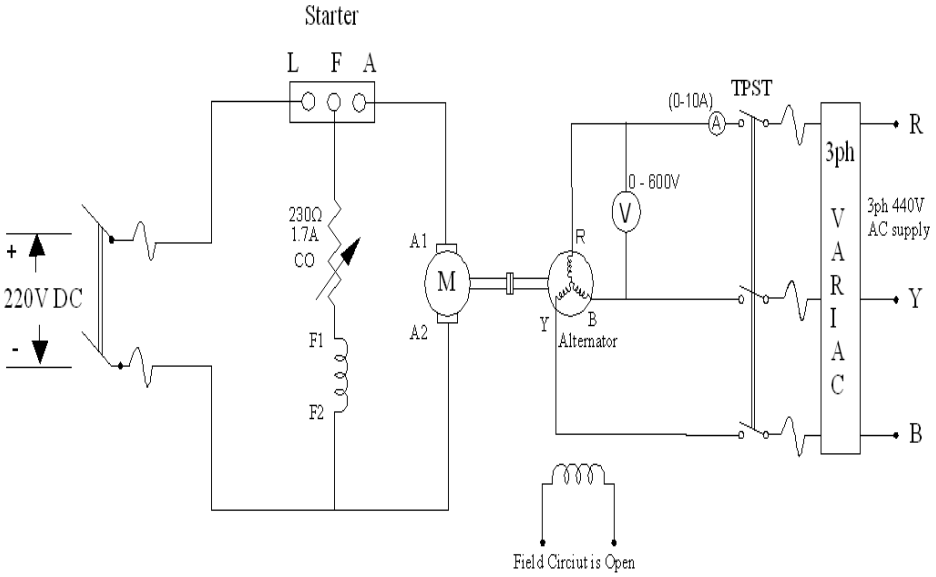
Experiment 11 : PERFORMANCE OF SYNCHRONOUS MOTOR CONNECTED TO INFINITE BUS, CONSTANT POWER VARIABLE EXCITATION & VICE VERSA

-	**Experiment No.:**	1	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	SLIP TEST ON SALIENT POLE ALTERNATOR						
2	Course Outcomes							
3	Aim							
4	Material / Equipment Required							
5	Theory, Formula, Principle, Concept							
6	Procedure, Program, Activity, Algorithm, Pseudo Code	step 1: step 2: step 3: step 4: step 5: step 6: step 7:						

7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	
9	Sample Calculations	
10	Graphs, Outputs	
11	Results & Analysis	
12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	

Experiment 12 : **POWER ANGLE CURVE OF SYNCHRONOUS GENERATOR**

-	**Experiment No.:**	1	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	POWER ANGLE CURVE OF SYNCHRONOUS GENERATOR						
2	Course Outcomes							
3	Aim							
4	Material / Equipment Required							
5	Theory, Formula, Principle, Concept							
6	Procedure, Program, Activity, Algorithm, Pseudo Code	step 1: step 2: step 3: step 4: step 5: step 6: step 7:						

7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	
9	Sample Calculations	
10	Graphs, Outputs	
11	Results & Analysis	
12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	