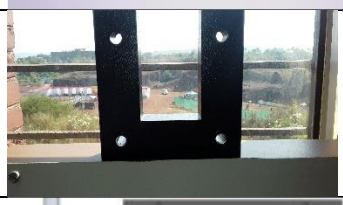
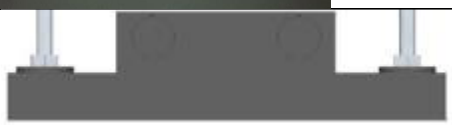
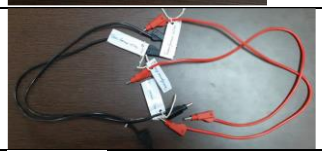
TRANSFORMER

Transformer Kit

S. No.	Items	Pictures	Quantity
1.	Securing Knobs		2
2.	Clamping Bar		1
3.	Clamping screw		2
4.	Yoke		1
5.	U- core		1
6.	Base for U-core		1
7.	Pole Pieces		2

8.	300 turns 4A assembly		1
9.	600 turns 2A assembly		2
10.	1200 turns 1A assembly		1
11.	3600 turns 0.3 A assembly		1
12.	12000 turn 0.05A assembly		1
13.	Vertical support Rod with support		1

14.	Power supply with power cord	2-12V (AC/DC), 5 A current	1
15.	Digital Multimeter		2
16.	Plain Quadrant Eddy plate		1
17.	Slotted Eddy current plate		
18.	Aluminium motor disc		1
19.	Connecting Leads pair 50 cm		4
20.	Washer		1

INDOSAW
COMMITTED TO EXCELLENCE

TRANSFORMER KIT

Instruction Manual

Manufacturer :

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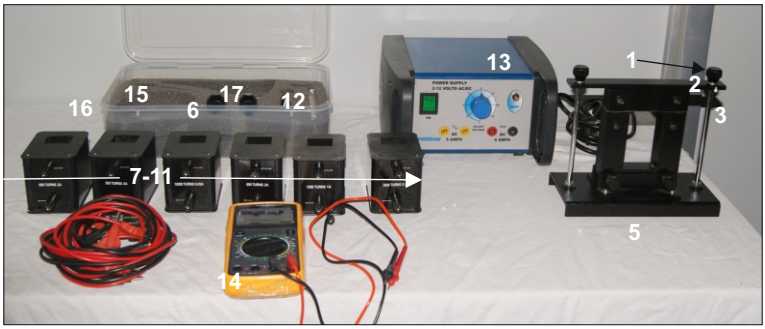
UNPACKING TRANSFORMER KIT

EXPERIMENTS:

Exp-1 To study working of step up Transformer.
Exp-2 To study working of step down Transformer.
Exp-3 Effect of Eddy Current.
Exp-4 To Demonstrate motor and Braking.
Exp-5 Principle of shaded pole motor.

CONTENTS:

S.No.	Item Name	Qty.
1.	Securing Knobs	2
2.	Clamping bar	1
3.	Yoke	1
4.	U-Core	1
5.	Base for U-Core	1
6.	Pole Pieces	2
7.	300 Turns 4A assembly	1
8.	600 Turn 2A assembly	2
9.	1200 Turn 1A assembly	1
10.	3600 Turn 0.3A assembly	1
11.	12000 Turn 0.05A assembly	1
12.	Vertical support Rod	1
13.	Power Supply	1
14.	Digital Multimeter	2
15.	Plain quadrant Eddy plate	1
16.	Aluminium Motor Disc	1
17.	Slotted Eddy Current plate	1
18.	Connecting leads pair	2



This apparatus has been designed primarily for demonstration of the basic principles of the a.c. transformer.

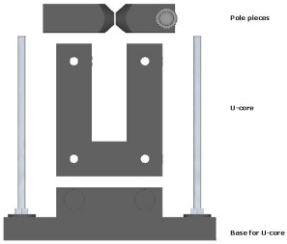
The various coils and cores will also serve as the basis of many experiments in electromagnetism, using either direct or alternating current. To this end, the number of turns, the direction of winding, and the continuous maximum rated current are marked on each coil.

WARNING:

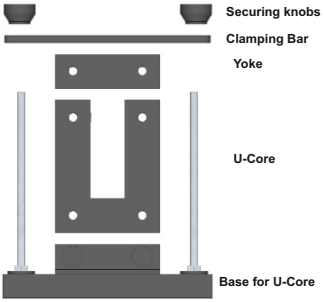
Users should be aware that some combinations of coils can create dangerously high voltages in the secondary coil, even when a low voltage power supply is used on the primary. Such combinations must not be used.

STANDARD CONFIGURATION
This is an exploded diagram of the transformer in its standard configuration – used for most experiments.

The U-core usually need not be removed from the base, other than for exploratory examination.



Note: Input power = Output power
$v_1 I_1 = v_2 I_2$
For ideal transformer



WARNING

The continuous current through the coil should not exceed the specified value for any length of time, as coils will overheat and may be irreparably damaged.

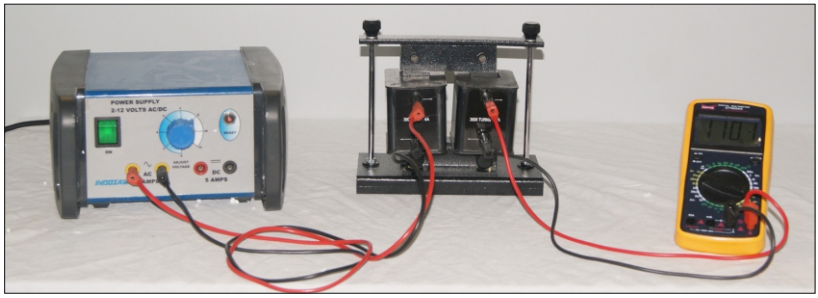
EXPERIMENT -1: TO STUDY WORKING OF STEP UP TRANSFORMER.
CONTENTS:

S. No.	Item Name	Qty.
1.	Securing Knobs	2
2.	Clamping bar	1
3.	Yoke	1
4.	U-Core	1
5.	Base for U-Core	1
6.	300 Turns 4A assembly	1
7.	3600 Turn 0.3A assembly	1
8.	Power Supply	1
9.	Digital Multimeter	1
10.	Connecting leads pair	2

PROCEDURE:
1. Set the two 300-turn coil on left of the U-core and 3600-turn coil on right.
2. Now clamp on the yoke.
3. Connect one coil having 300-turn to a 12V A.C. power supply and the other having 3600- turn to the Digital Multimeter.
4. Now Observe the voltage on Digital Multimeter, the voltage has been increased as per formula:

N1V2=N2V1

Where N1 and N2 are no. of turns of coil 1 and 2 respectively and V1 and V2 is their corresponding voltage.



EXPERIMENT- 2: TO STUDY WORKING OF STEP DOWN TRANSFORMER.

CONTENTS:

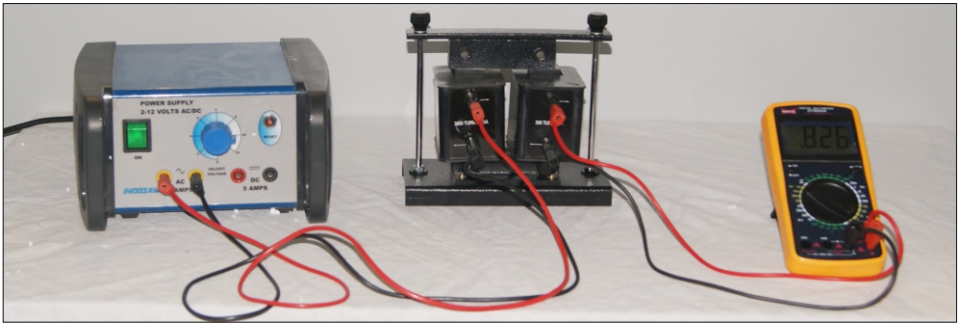
S. No.	Item Name	Qty.
1.	Securing Knobs	2
2.	Clamping bar	1
3.	Yoke	1
4.	U-Core	1
5.	Base for U-Core	1
6.	300 Turns 4A assembly	1
7.	3600 Turn 0.3A assembly	1
8.	Power Supply	1
10.	Connecting leads pair	2

PROCEDURE:

1. Set the two 3600-turn coil on left of the U-core and 300-turn coil on right.
2. Now clamp on the yoke.
3. Connect one coil having 3600-turn to a 12V A.C (V_1). power supply and the other having 300- turn to the Digital Multimeter.
4. Now Observe the voltage on Digital Multimeter, the voltage (V_2) has been decreased as per formula:

$$N1V2=N2V1$$

Where N1 and N2 are no. of turns of coil 1 and 2 respectively and V1 and V2 is their corresponding voltage.



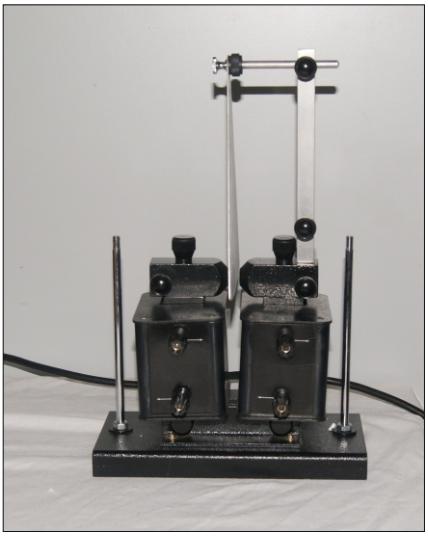
EXPERIMENT -3: EFFECT OF EDDY CURRENT

CONTENTS:

S. NO.	Item Name	Qty.
1.	U-Core	1
2.	Base for U-Core	1
3.	Pole Pieces	2
4.	600 Turn 2A assembly	2
5.	Vertical support Rod	1
6.	Power Supply	1
7.	Digital Multimeter	1
8.	Plain quadrant Eddy plate	1
9.	Slotted Eddy Current plate	1
10.	Connecting leads pair	2

PROCEDURE:

1. Set the two 600 turn coils on the U-core and attach the pole pieces.
2. Connect the two coils in series with each other and a low voltage variable d.c. power supply, and a 0-5A d.c. ammeter.
3. Mount the plain eddy current plate as illustrated, and check that it swings freely between the pole pieces.
4. Switch on the power supply and adjust the voltage to get a coil current of 1.5-2A.
5. Attempt to swing the eddy current plate through the pole pieces again, and note how the swinging motion is damped.
6. Replace the plain eddy current plate with the slotted one, and repeat the experiment. Observe how the damping effect is still present, but much reduced. This is because the eddy currents induced in the plate are broken up by the slots.



EXPERIMENT -4: TO DEMONSTRATE MOTOR AND BRAKING

CONTENTS:

S. NO.	Item Name	Qty.
1.	U-Core	1
2.	Base for U-Core	1
3.	Pole Pieces	2
4.	600 Turn 2A assembly	2
5.	Vertical support Rod	1
6.	Power Supply	1
7.	Digital Multimeter	1
8.	Aluminium Motor Disc	1
9.	Connecting leads pair	2

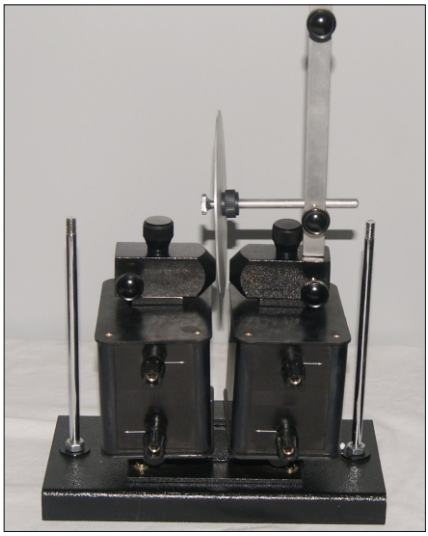
PROCEDURE:

1. Set the two 600 turn coils on the U-core and attach the pole pieces.
2. Connect the two coils in series with each other and a low voltage variable d.c. power supply, and a 0-5A d.c. ammeter.
3. Mount the aluminium motor disc. as illustrated, and check that it swings freely between the pole pieces.
4. Adjust the height of the support rod so that the aluminium disc passes between the pole pieces, as illustrated. Ensure it can spin freely between the pole pieces.
5. Wind a long piece of string or thread around the spindle, the purpose being to be able to pull the string to start the aluminium disc spinning quickly.
6. Set the disc spinning, and observe how long friction on the spindle causes the disc to slow to a stop.
7. Wind the string again, and start the disc spinning as before. When it is spinning, turn on the power again. Observe how the induced eddy currents bring the disc to a stop quickly.

The large eddy currents are setup in the metal disc due to change of magnetic flux. The eddy currents produce a torque in a direction which opposes the motion of disc and stop it . Force due to eddy current

$$F \alpha V$$

Thus breaking effect is smooth.



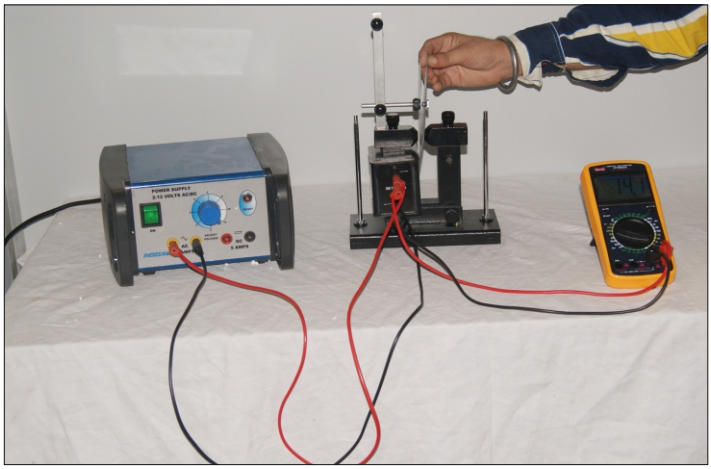
EXPERIMENT - 5: PRINCIPLE OF SHADED POLE MOTOR (Energy Meters)

CONTENTS:

S. NO.	Item Name	Qty.
1.	U-Core	1
2.	Base for U-Core	1
3.	Pole Pieces	2
4.	300 Turn 4A assembly	1
5.	Plain quadrant Eddy plate	1
6.	Vertical support Rod	1
7.	Power Supply	1
8.	Digital Multimeter	1
9.	Aluminium Motor Disc	1
10.	Connecting leads pair	2

PROCEDURE:

1. Set the 300 turn coil on the U-core, and attach the flat pole pieces.
2. Mount the aluminium motor disc so that it can spin freely between the pole pieces.
3. Connect the coil to a low voltage a.c. power supply and set to 20-25V.
4. Now, slowly insert the plain eddy plate between the aluminium motor disc and one of the pole pieces so that it 'shades' part of the pole.
5. The aluminium disc should start to rotate.



NOTE: Power supply required to perform this experiment is provided with demonstration meter kit.

TEACHING NOTES AS EYE CATCHERS (MEMORY TIPS)
TO MAKE CONCEPTS ONLY (NOT FOR DEMONSTRATION)
XII CLASS

1, TRANSFORMER:- The transformer which convert low alternating current voltage into high alternating current voltage is called as step up transformer and vice versa(called as step down transformer)

2, PRINCIPLEOF TRANSFORMER:- MUTUAL INDUCTION :- The production of induced current in a circuit by changing current in the neighbouring circuit is called as mutual induction.

3, SELF INDUCTION :- The production of induced current in a circuit by changing the current in the same circuit is known as self induction.

4 FOR A IDEAL TRANSFORMER :- $\frac{I_2}{I_1} = \frac{N_1}{N_2} = \frac{E_1}{E_2} = K$

K is called as transformation ratio, of turns in secondary and primary coil.

5, EFFICIENCY OF IDEAL TRANSFORMER**:-** η = OUTPUT POWER / INPUT POWER

$$\frac{E_2 I_2}{E_1 x I_1} = 1$$

6: In the transformer the induced emf of primary E_1 and that of secondary E_2 are out of phase.

7: The direct current can not be stepped up or stepped down by transformer.

7: The transformer does not amplify power.

8: The eddy current do not cause sparking.

Note – N_1 and N_2 are turns in primary and secondary coil of transformer.

9. ENERGY LOSSES IN TRANSFORMER

a) Loss of magnetic flux :- Because whole of the magnetic flux produced by the primary coil not linked with the secondary. (as no coupling is perfect)

b) Iron losses :- It is due to the heat produced by eddy currents produced even in the laminated core.

c) Copper losses :- It is due to heat produced , due to the resistance of copper coil, due to large length of wire of cu.

d) Hysteresis loss :- It is due to repeated orientation and reorientations of molecular magnets of core during its magnetisation and demagnetisation.

e) Humming losses :- It is due to humming produced due to the vibration set up in the parts of transformer due to alternating current.

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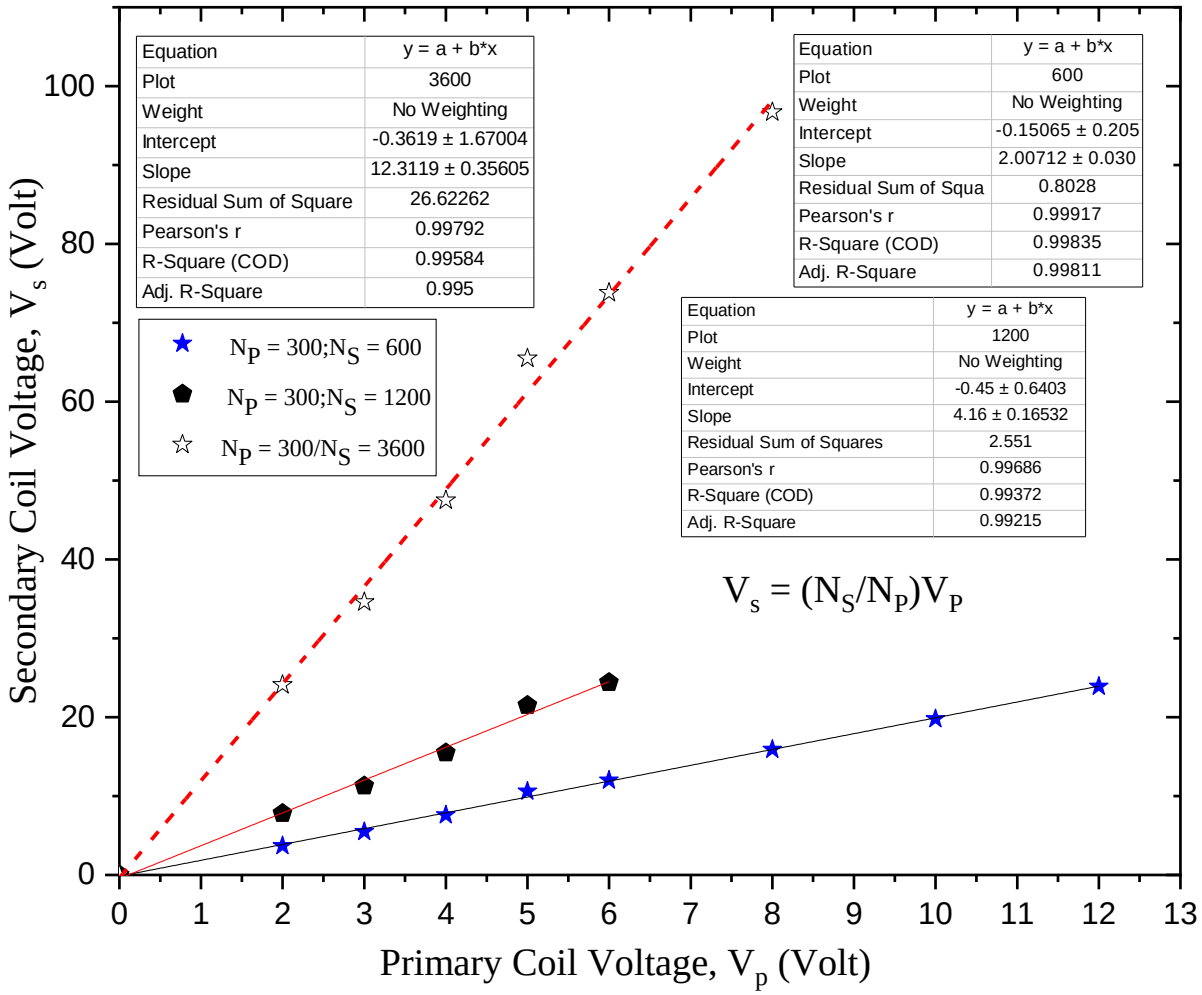
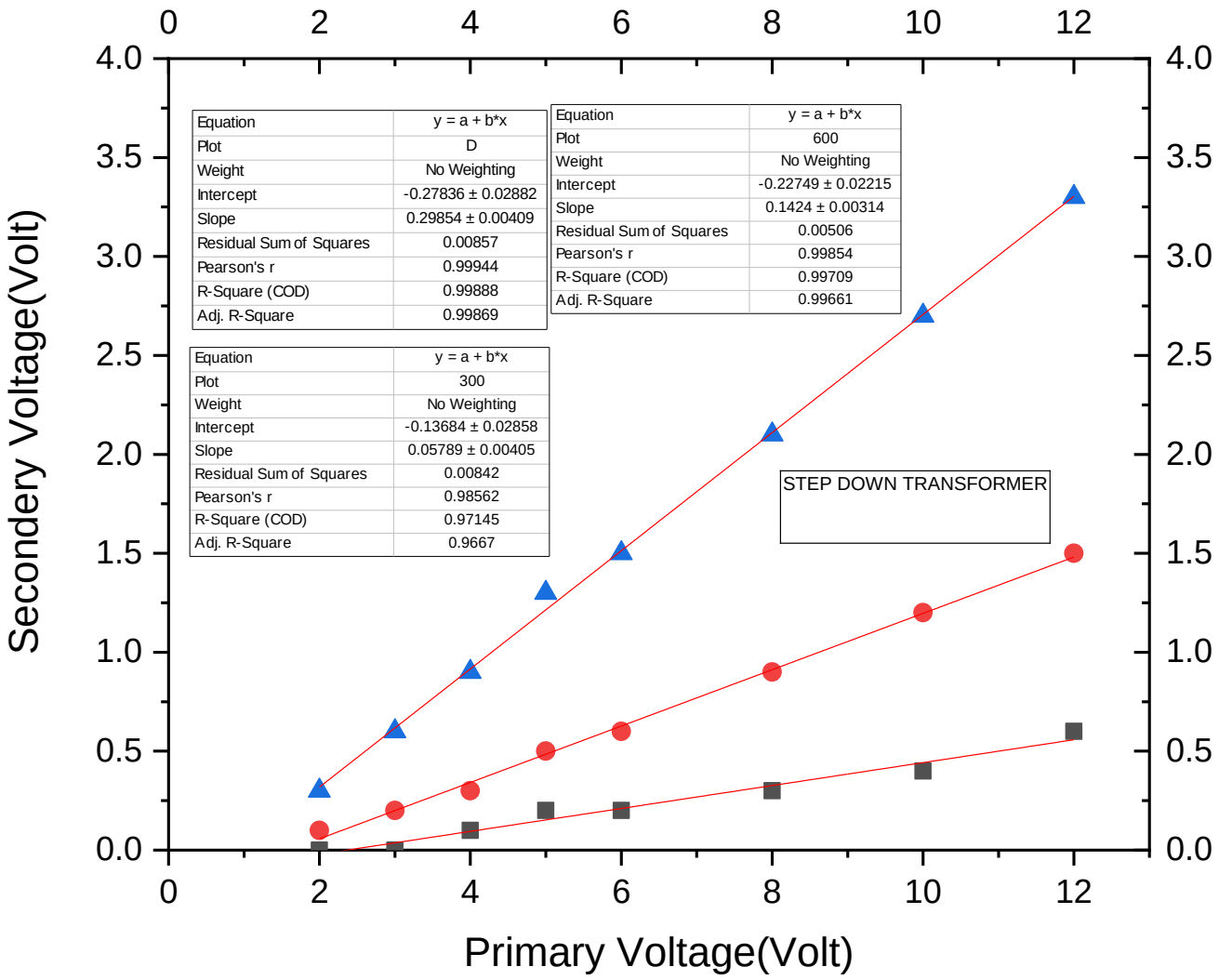
Transformer: Step-up Data

No. of turns in primary(Np)	No. of turns in secondary(Ns)	V_p	V_s	$\frac{N_s}{N_p} = m_1$	Graph 1 Slope (m_2)	Graph 2 Slope (m_3)	Graph 3 Slope (m_4)	$V_s = (\frac{N_s}{N_p})V_p$ (Volt)
300	600			2				
300	1200			4				
300	3600			12				




Secondery Voltage(Volt)
Primary Voltage(Volt)
0
2
4
6
8
10
12
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Equation | y = a + b*x
Plot | D
Weight | No Weighting
Intercept | -0.27836 ± 0.02882
Slope | 0.29854 ± 0.00409
Residual Sum of Squares | 0.00857
Pearson's r | 0.99944
R-Square (COD) | 0.99888
Adj. R-Square | 0.99869
Equation | y = a + b*x
Plot | 600
Weight | No Weighting
Intercept | -0.22749 ± 0.02215
Slope | 0.1424 ± 0.00314
Residual Sum of Squares | 0.00506
Pearson's r | 0.99854
R-Square (COD) | 0.99709
Adj. R-Square | 0.99661
Equation | y = a + b*x
Plot | 300
Weight | No Weighting
Intercept | -0.13684 ± 0.02858
Slope | 0.05789 ± 0.00405
Residual Sum of Squares | 0.00842
Pearson's r | 0.98562
R-Square (COD) | 0.97145
Adj. R-Square | 0.9667
STEP DOWN TRANSFORMER