DEPARTMENT OF

ELECTRICAL ENGINEERING

Motilal Nehru National Institute of Technology Allahabad
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EE-16204
Electrical Machines-II Lab
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TITLE

V curve and inverter V curve of a synchronous motor.

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Experiment No: 4

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Roll No: 20192016

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Class Ee1

REMARKS

Grade ____________________

Report accepted by ____________________

Report accepter on ____________________

V curves and V inverter curves of a synchronous motor

Date
16-02-22

Experiment No - 4

Navneet Pathak
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Aim:- The aim of experiment is to draw the V and inverted V curves of three phase synchronous motor.

Apporatus Required:-

S.No	Name of apparatus	Range	Type	Quantity
1.	Ammeter	(0-10) A	MI	1
2.	Ammeter	(0-2) A	MC	1
3.	Voltmeter	(0-600)V	MI	1
4.	Wattmeter	600, 10A	EDM	2
5	Tachometer	(0-3000) rpm	Digital	1
6.	Connecting Wires	2.5mm²	Cu\Al	Few

Name plate details:-

Rated Voltage:- 400 V
Rated Current:- 16 A
Rated Power:- 12.5 HP

Theory:- In AC electromagnetic device magnetizing current or lagging device reactive VA, drawn from AC sources is to set up the flux the magnetic circuit of device. A synchronous motor is doubly-excited machine. When synchronous machine is working at a constant applied voltage, the resultant air gap flux as dema-nded by constant supply voltages, remains sub stantially constant by following equation,

$$\phi_{air\,gap} = \frac{V_t}{\sqrt{2}\pi f k_w T_{ph}}$$

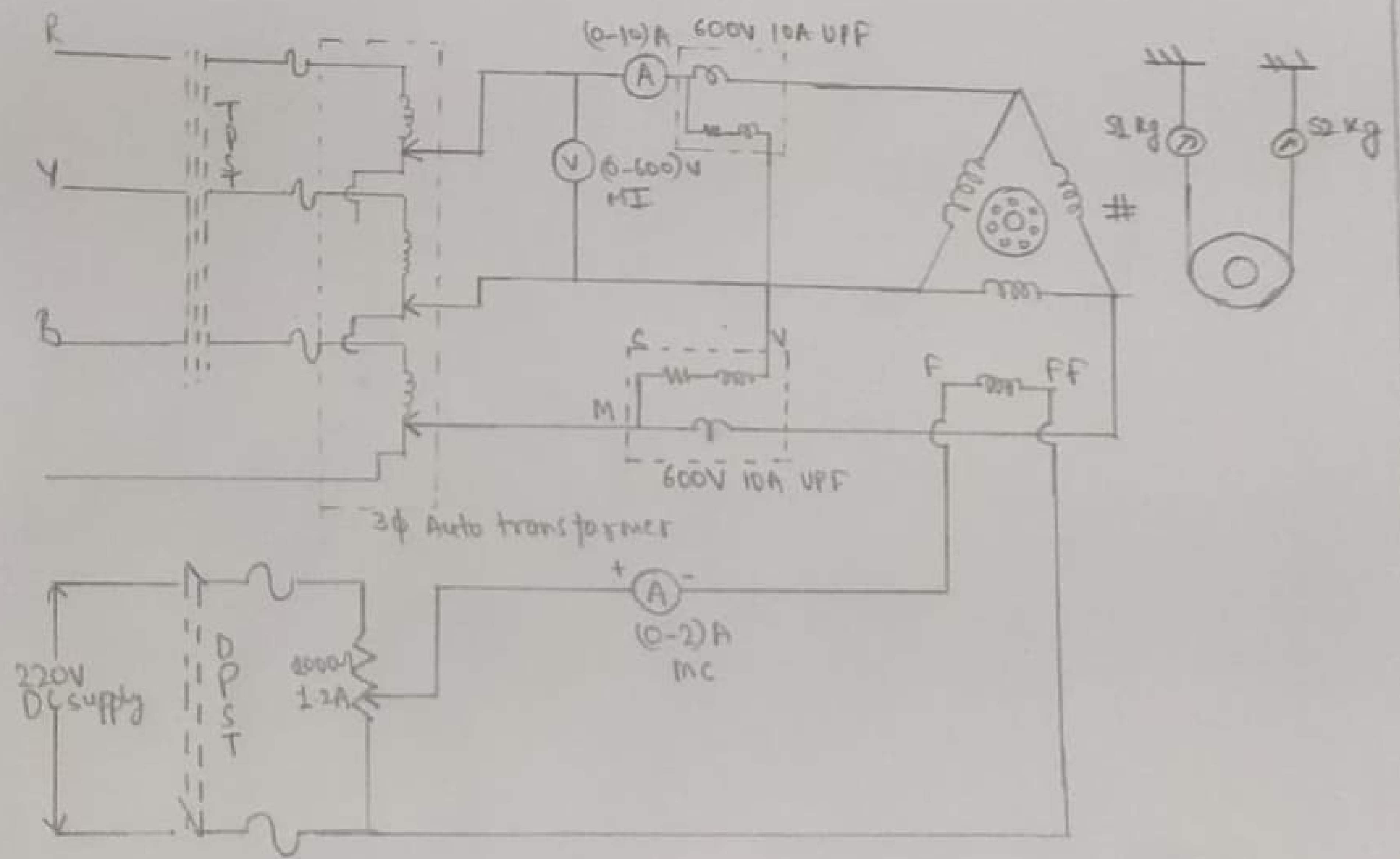
This resultant air gap flux is established by the co-operation of both a.c. in armature winding and dc in field winding. If the field current is sufficient enogh to set up the air gap flux, as demanded by the constant V_t then magnetzing current or lagging reactive VA required from the AC source is 0 and therefore the motor operates at unity power factor. This field current is excitation or normal field current.

→ If the field current is made less than the normal excitation i.e. the motor is under excite, then the deficiency in flux must be made up by the armature winding m.m.f. In order to do the needful, the armature draws a magnetizing current from the AC source and a result of it, motor operates at lagging power factor.

→ If the field current is more than the normal excitation i.e. the motor is over excite, then the excess flux must be neutralized by the armature winding mmf. The armature can do so only if it draws a demagnetizing current from the A.C. source. Since in motor, magnetizing current lags the applied voltage by about 90', demagnetizing current must be leads the applied voltage by about 90', So motor operates at leading power factor.

Procedure:-

1. Note down the ~~m~~ name plate details of motor.
2. Connections are given as per circuit diagram.
3. Close the TPST switch.
4. By adjusting the auto transformer from min position to max position at rated supply is given to the motor. The motor starts as induction motor.
5. In order to give the excitation to the field winding close the DPST switch.
6. By varying the field current with the help of field rheostat from under excitation to over excitation note down the armature current and the input power at no-load, half and full load.
7. Later reduce the load and the motor is switched off after observing the precautions. Note down the readings of ammeters and voltmeters readings.



R
Y
B
TPST
(0-10)A
600V 10A UPF
(0-600)V
MI
S1 kg
S2 kg
#
C
V
M
L
F
FF
600V 10A UPF
3φ Auto transformer
(0-2)A
MC
220V
DC supply
DPST
1.2A

Observation Table:-

S. No.	Excitation Current I_f (A)	Armature Current I_a (A)	W_1 Reading MF = 8	W_2 reading MF = 8	$\cos\phi$
1.	0.8	15.1	460	-360	0.0711
2.	0.9	14.1	400	-280	0.1013
3.	1.1	12.5	360	-120	0.2774
4.	1.3	10.1	330	-70	0.3513
5.	1.5	7.2	290	-40	0.401
6.	1.7	4.1	180	0	0.499
7.	1.9	3	125	30	0.657
8.	2.1	2	80	60	0.97
9.	2.3	3.5	0	150	0.499
10.	2.5	6.1	-30	240	0.4099
11.	2.7	9.2	-80	320	0.3267
12.	2.9	12.1	-160	370	0.2239
13.	3.2	14	-280	400	0.1014

Formula Used:-

$\cos\phi = P_i / \sqrt{3}\, V_L I_L$

where ϕ = Phase angle between voltage and current

P_i = Input Power

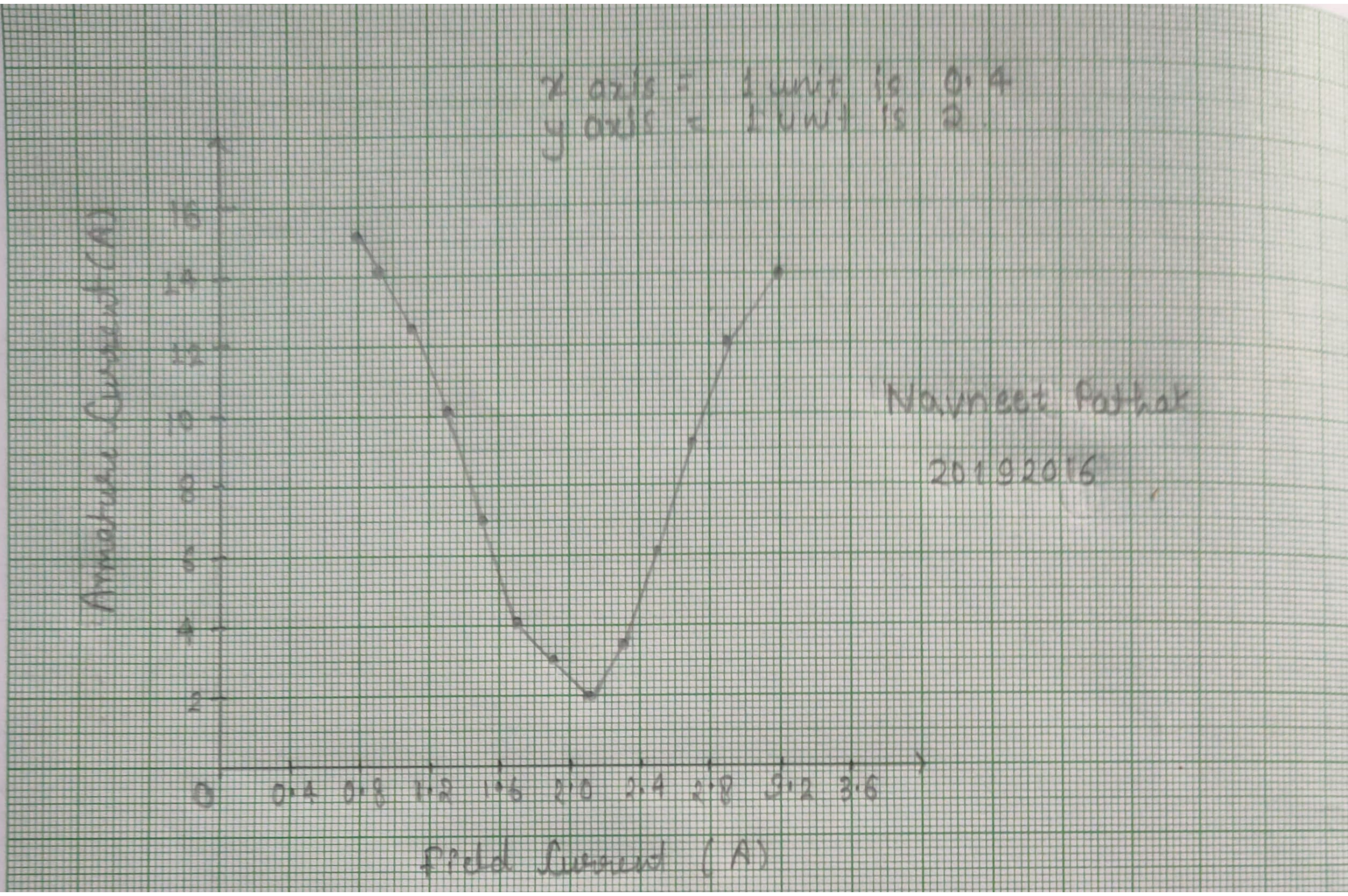
V_L = Line Voltage

I_L = Line Current

$$\cos\phi = \cancel{\cos}\ \cos\left[\tan^{-1}\left\{\sqrt{3}\left(\frac{W_1 - W_2}{W_1 + W_2}\right)\right\}\right]$$

→ W_1 = Wattmeter reading 1

W_2 = Wattmeter reading 2.



x axis = 1 unit is 0.4
y axis = 1 unit is 2
Armature Current (A)
16
14
12
10
8
6
4
2
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
3.2
3.6
Field Current (A)
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x axis 1 unit = 0.4

y axis 1 unit = 0.1

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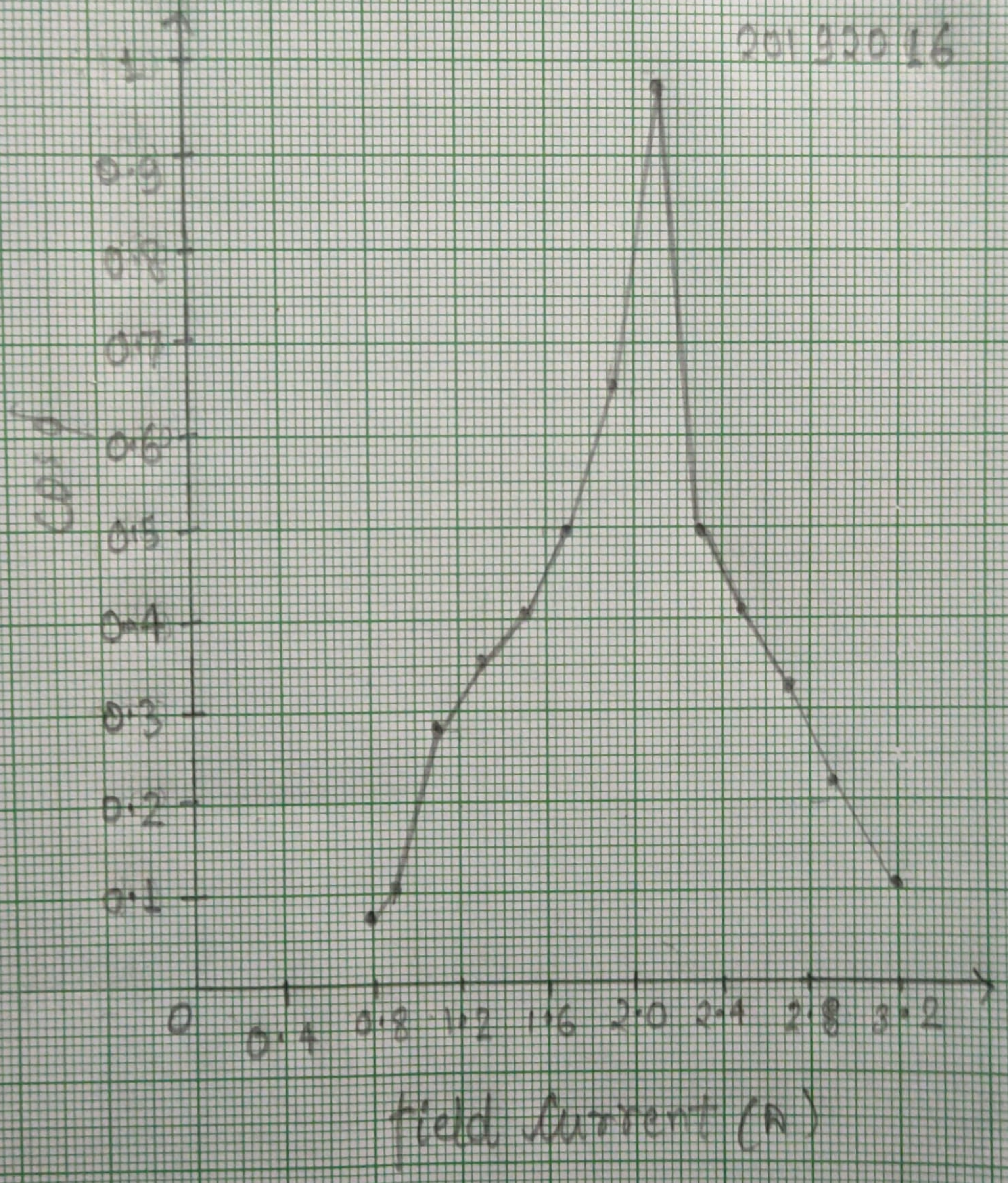

Calculation:-

S. No.	W_1	W_2	$\frac{W_1 - W_2}{W_1 + W_2}$	$\cancel{\tan^{-1}}\ \sqrt{3}\left[\frac{W_1 - W_2}{W_1 + W_2}\right]$	$\tan^{-1}\left[\frac{\sqrt{3}(W_1 - W_2)}{W_1 + W_2}\right]$	$\cos\left[\tan^{-1}\left(\frac{\sqrt{3}(W_1 - W_2)}{W_1 + W_2}\right)\right]$
1.	460	-360	8.2	14.2028	1.4996	0.0711
2.	400	-280	5.67	9.82072	1.46932	0.1013
3.	360	-120	2	3.464	1.28975	0.2774
4.	330	-70	1.5385	2.665	1.21182	0.3513
5.	290	-40	1.32	2.286	1.1584	0.401
6.	180	0	1	1.7321	1.0472	0.499
7.	125	30	0.6129	1.0616	0.8536	0.657
8.	80	60	0.14285	0.2474	0.2425	0.97
9.	0	150	-1	-1.7321	-1.0472	0.499
10.	-30	240	-1.2857	-2.2269	-1.1487	0.4099
11.	-80	320	-1.67	-2.893	-1.238	0.3267
12.	-160	370	-2.524	-4.37169	-1.348	0.2238
13.	-280	400	-5.667	-9.8155	-1.4692	0.1014

Result:- With the help of the experimental values, we have calculated power factor and plotted graph for V curve and inverted V curve respectively.

Precautions:-

(1) The potential divider should be in maximum position.

(2) The motor should not be started without load.

(3) Initially TPST swith is in open position.